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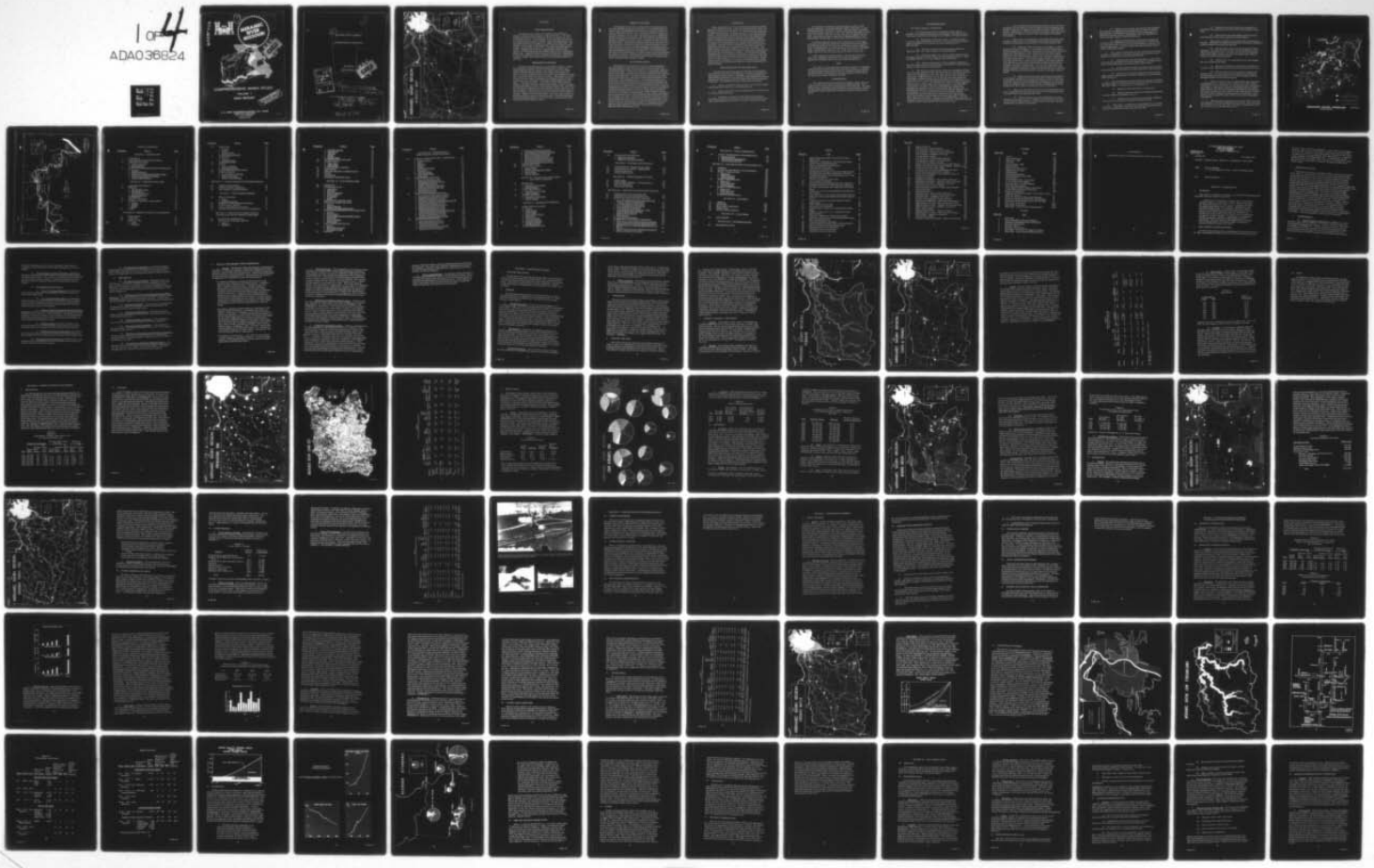

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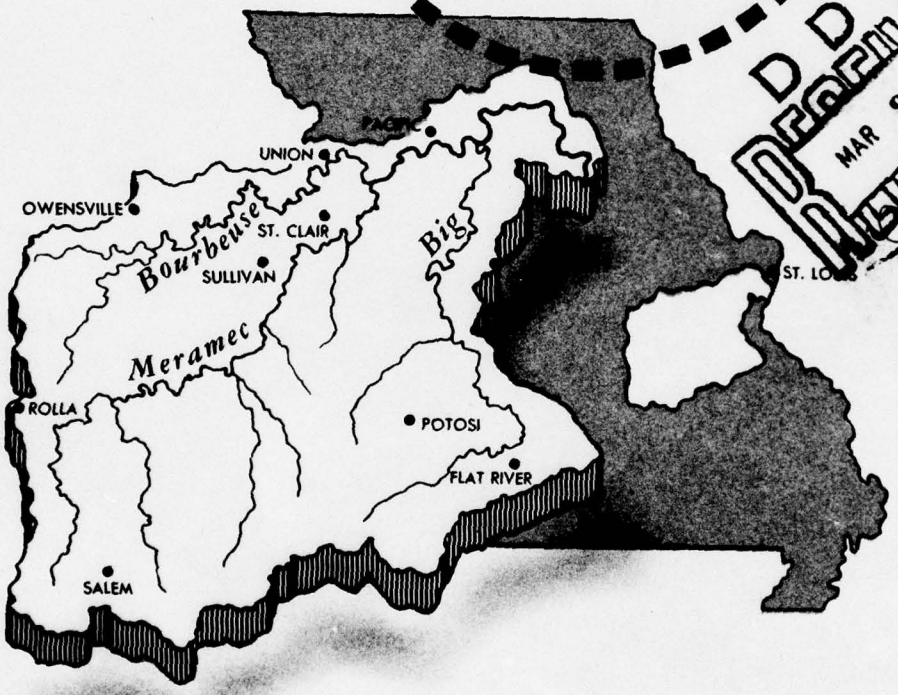

COMPREHENSIVE BASIN STUDY

VOLUME I

MAIN REPORT

U. S. ARMY ENGINEER DISTRICT, ST LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

JANUARY 1964

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MERAMEC RIVER, MISSOURI

COMPREHENSIVE BASIN STUDY.

VOLUME I.

MAIN REPORT.

(21) ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

See also Volume 2, AD-A036 825.

U. S. Army Engineer District, St. Louis
Corps of Engineers
St. Louis, Missouri

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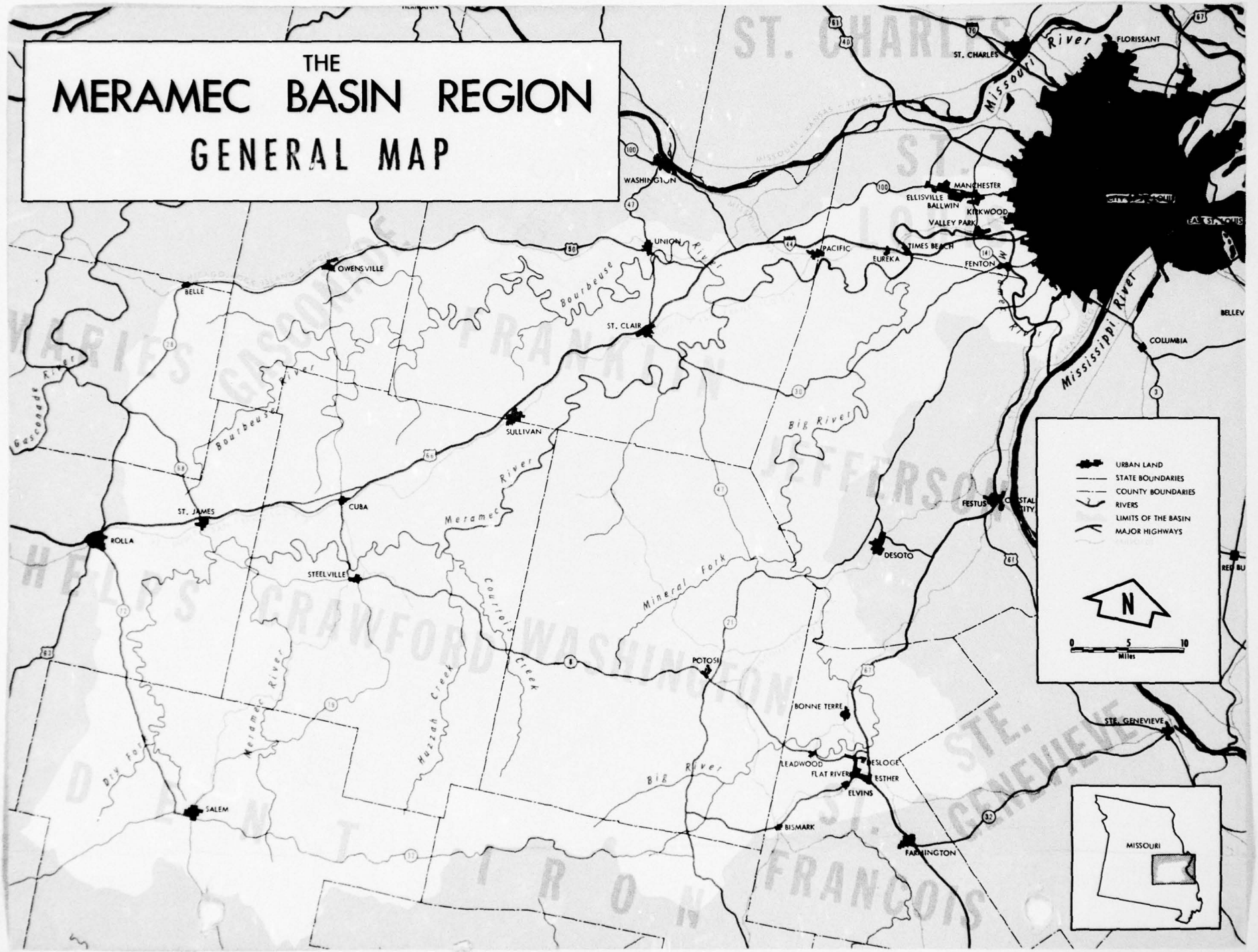
THE
MERAMEC BASIN REGION
GENERAL MAP
ST. CHARLES
Missouri River
FLORISSANT
WASHINGTON
MANCHESTER
ELLISVILLE
BALLWIN
KIRKWOOD
VALLEY PARK
ST. LOUIS
UNION
PACIFIC
EUREKA
TIMES BEACH
FENTON
OWENSVILLE
BELLE
Bourbeuse River
ST. CLAIR
Gasconade River
SULLIVAN
Big River
Mississippi River
COLUMBIA
ST. JAMES
CUBA
Meramec River
ROLLA
STEELVILLE
FESTUS
DESOTO
Mineral Fork
Courtois Creek
POTOSI
Huzzah Creek
Dry Fork
Meramec River
BONNE TERRE
LEADWOOD
DESLOGE
FLAT RIVER
ESTHER
ELVINS
STE. GENEVIEVE
SALEM
BISMARK
FARMINGTON
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
N
0 5 10
Miles
MISSOURI

SYLLABUS

BASIN DESCRIPTION

The Meramec River Basin lies wholly within the State of Missouri and drains approximately 3,980 square miles. The major streams of the basin are the Meramec River, the Big River, and the Bourbeuse River. The topography of the basin may be described as a highly dissected plateau with land surfaces sloping gently to the north and becoming increasingly more rugged toward the south. The climate is of the interior continental type, with wide ranges in daily, monthly, and seasonal temperatures. Average rainfall is about 39 inches. Population of the basin is approximately 212,000 (1960 census), of which almost one-half resides within the St. Louis metropolitan area. Approximately 62 percent of the basin is in timberland, 35 percent in cropland, and the remaining in other uses. Agriculture, forestry, mining, and manufacturing are the principal industries in the basin.

PROBLEMS IN THE BASIN

The flow of the Meramec River is extremely variable - insufficient during dry summer periods and destructive at other times. During many periods the streams in the basin do not carry enough water to provide adequate dilution of the wastes which empty into them, nor do the stream flows provide suitable environment for recreation or favorable habitat for fish and wildlife. Approximately 129,400 acres of land are subject to flooding in the Meramec Basin, of which 10,500 acres are also subject to flooding by Mississippi River backwater. The towns of Fenton, Times Beach, Valley Park, Pacific, Glencoe, and Cedar Hill have experienced flooding. Current average annual flood damages amount to approximately $1,903,000. Recreation has long been an important use of the Meramec Basin. However, with the exception of a few private lakes and minor developments along the natural streams, water-based recreation facilities are practically nonexistent. Outside of the metropolitan St. Louis area, the economy of the basin presently verges on semi-depressed. Persistent unemployment and underemployment currently prevail in seven counties which lie wholly or partly within the basin.

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NEEDS OF THE BASIN

The population of the basin, particularly in the lower portion, will show a significant growth in the future. It is estimated that, by the year 2000, the population of the basin will increase to 640,000, and to 3,000,000 by the year 2070. Except for the lower reaches of the basin adjacent to the St. Louis metropolitan area, no significant change in land use is anticipated. Substantial growth in manufacturing can be expected in the lower basin. The need for space for this increase in manufacturing will require utilization of land in the lower Meramec Basin. Increased development in the basin will also occur from new mineral discoveries and more efficient production of iron, lead, and other ores; from increased demands for products of agriculture; and from rehabilitated and improved forest management with new and expanded markets for wood materials. Provision of lakes and water-based developments is needed to meet the pressing demands for outdoor recreation. Influencing this potential growth will be the ability of the streams in the basin to provide water in adequate quantities and quality when and where needed.

PLAN FORMULATION

The objective of this study is to devise a sound program for the development of water and related land resources to meet the immediate and long-range needs of the basin in an orderly, efficient, and timely manner. To meet this objective, consideration has been given to watershed treatment of agricultural lands and forest improvements in the upper basin; multiple-purpose reservoirs on the main streams and tributaries; and levees and flood plain regulation in the lower basin. Development of water and related land resources is based on retention of substantially all present agricultural land with productivity increased by improved farming practices and flood control; retention of substantially all present forest land under improved management; provision of an adequate supply of water for anticipated urban and industrial growth in the lower valley and for dilution to maintain water quality control after practicable treatment of pollution sources; prevention of flood damages to agricultural and potential urban and industrial areas; preservation and improvement for public use of outdoor recreation, presently afforded by streams and forests, and development of water areas to meet a growing demand for water-based recreation; and production of hydroelectric power where practicable to provide needed peaking capacity to supplement the predominant steam-generated capacity of systems now serving the Meramec Basin and adjoining areas.

BASIN PLAN

After consideration of various alternative solutions for satisfying present and future needs, a plan was developed for the basin consisting of 7 main stream reservoirs, 12 tributary stream reservoirs, 12 headwater reservoirs, 26 angler-use sites, and 9 local protection projects. The basin plan would provide flood control approximately equal to standard project flood protection in the lower basin with a practical degree of protection in the upper basin against floods of from 10- to 50-year frequencies; all the required water quality control needs and all supplemental water supply requirements to the year 2070; recreation and fish and wildlife development to meet the immediate and future needs to the fullest practicable extent; and improvement of economic conditions in the upper basin area. The plan is flexible and provides for extension of services as they become necessary and are justified in the future. The Southwestern Power Administration, in reviewing the hydroelectric potential, stated that the power which would be produced could not be marketed at the indicated cost and load factor, now or in the foreseeable future. Hydroelectric power development is retained in the basin plan for further consideration at such time as the need for, and the marketability of, power warrants.

IMPLEMENTATION OF THE BASIN PLAN

The selection of the time sequence and order of development for the various elements in the basin plan are based on the projected time patterns of water resource demands. Present proposals for initial Federal participation are limited to those elements of the basin plan that current and projected needs indicate should be constructed at this time. The following order of construction is proposed:

a. Initial construction within the next 10 to 15 years of those improvements for which there is an imminent need.

b. Later construction of those improvements for which there is a foreseeable future need.

c. Deferred construction of those improvements which presently lack economic justification but which may be needed in the long-range program at such time as economic conditions warrant.

The following components of the basin plan, as shown on the attached drawings, are recommended for initial construction: 4 main stream reservoirs - Pine Ford, Irondale, Meramec Park, and Union; 3 tributary stream reservoirs - I-26, I-28, and I-38; 6 headwater reservoirs - H-3, H-5A, H-8, H-9, H-13A, and H-25; 21 angler-use sites; and 5 local protection improvements for the Starling Airport, West Watson Road, Weiss Airport, Valley Park, and Peerless Park areas.

Following completion of the initial construction, the following elements in the basin plan should be reevaluated to determine whether the projected needs are still valid and justification exists on which to base a recommendation for authorization and construction; Washington Park, Virginia Mines, Salem, I-33A, I-35A, H-4, H-6, H-11A, 3 angler-use sites, and local protection for the Butler Lakes area.

After completion of improvements in the second construction phase, the remaining components of the basin plan should be re-examined to determine their need and economic justification.

COST

The total cost of the basin plan, exclusive of power, is estimated at $236,228,000, of which $129,156,000 would be required to complete the initial improvements, $66,052,000 for subsequent improvements, and $41,020,000 to complete the remaining elements at such time as the needs and economic conditions warrant.

COORDINATION

The combined efforts of all interested Federal, State, and local agencies in the water resources field were utilized and their views given careful consideration in development of the basin plan. The study has been fully coordinated with and has taken into account the views of the Meramec Basin Corporation in matters of Federal interest in the basin.

RECOMMENDATIONS

The District Engineer recommends:

a. That the plan generally as formulated in this report be adopted as the comprehensive plan for development and beneficial uses of the water resources of the Meramec River Basin. The plan includes:

(1) Seven main stream reservoirs, 12 tributary stream reservoirs, and 12 headwater reservoirs, as listed and for the purposes shown in TABLES 43, 44, and 45, at a total estimated cost of $216,820,000.

(2) Nine local flood protection projects for urban and industrial areas, at a total estimated cost of $18,688,000.

(3) Twenty-six angler-use sites to provide needed access and stopover points for float fishing, as recommended by the U. S. Fish and Wildlife Service, at a total estimated cost of $720,000.

(4) Further consideration of the hydropower potential at the main stream reservoirs at such time as the need for, and the marketability of, power warrant such provision.

b. That four of the main stream reservoirs, designated as Pine Ford, Irondale, Meramec Park, and Union; three of the tributary stream reservoirs, designated as I-26, I-28, and I-38; six of the headwater reservoirs, designated as H-3, H-5A, H-8, H-9, H-13A, and H-25; 21 of the angler-use sites downstream of the applicable aforementioned reservoirs; and five of the local protection projects, designated as areas Nos. 4, 8, 9, 11, and 12, be authorized for construction for the purposes of flood control, water supply, water quality control, fish and wildlife conservation, recreation, and area redevelopment, as applicable, generally in accordance with the comprehensive plan and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at a total estimated cost of $129,156,000, of which $118,095,000 would be Federal cost and $11,061,000 non-Federal cost, which includes reimbursable costs amounting to $8,731,000 for water supply and recreation. Annual costs for maintenance, operation, and major replacements are estimated at $1,738,000, of which $1,425,500 would be Federal costs and $312,500 non-Federal costs.

c. That, immediately following authorization of the reservoirs and angler-use sites listed in b above, sufficient site investigations and designs be made for the purpose of defining the project lands required, and that, subsequently, advance acquisition be made of such title to such lands as may be required to preserve the sites against incompatible developments.

d. That, prior to construction of each of the main stream and tributary stream reservoirs, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Repay the costs allocated to water supply, as determined by the Chief of Engineers, in accordance with the provisions of the Water Supply Act of 1958, as amended by the Federal Water Pollution Control Act Amendments of 1961. Such costs will be determined by applying the percentages given in TABLE 57 for reservoirs listed in b above to actual costs for initial construction, operation, maintenance, and major replacements. Cost of water supply storage to meet needs over the first 50 years of the period of analysis is presently estimated at $2,483,000 for construction and $24,800 annually for maintenance, operation, and major replacements. Cost of water supply from conversion of storage to meet the needs covering the last 50 years of the period of analysis is presently estimated at $5,590,000 for construction and $43,700 annually for maintenance, operation, and major replacements.

(2) Repay that portion of the construction costs allocated to recreation, including the recreational aspects of fish and wildlife, in accordance with the cost sharing policy outlined in H. R. 9032, 88th Congress. Such costs will be determined by applying the percentages given in TABLES 54 and 55 to actual costs for construction, presently estimated for those reservoirs listed in b above at $103,000.

e. That, prior to construction of each of the headwater reservoirs, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way, including relocations and access roads for all works of improvement for purposes other than public fish and wildlife and recreational development.

(2) Repay 50 percent of the construction costs allocated to recreation, including the recreational aspects of fish and wildlife. Such costs will be determined by applying the percentages given in TABLE 60 to actual costs for construction, presently estimated for those reservoirs listed in b above at $555,000.

(3) Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of the Army or in lieu thereof pay the annual costs of maintenance, operation, and major replacements, currently estimated for the reservoirs listed in b above at $81,800 annually.

f. That, prior to construction of each of the reservoirs listed in b above, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Undertake all practicable measures to control pollution of the streams subject to low-flow augmentation by adequate treatment or other methods of controlling wastes at their source.

(2) Protect channels downstream of the reservoirs from encroachment which would adversely affect operation of the reservoirs.

(3) Hold and save the United States free from all water rights claims resulting from construction, operation, and maintenance of the reservoirs.

g. That non-Federal interests be given the option to reimburse the United States for the portion of first costs of each reservoir, other than water supply, for which they are responsible, by:

(1) Payment in lump sum prior to construction.

(2) Payment during construction in amounts proportional to annual Federal construction costs, or

(3) Payment over a period of 50 years after completion of the project, with interest during the repayment period.

h. That, prior to construction of each angler-use site listed in b above, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Maintain and operate the site after completion in accordance with regulations to be prescribed by the Secretary of the Army.

(2) Hold and save the United States free from claims resulting from construction, operation, and maintenance.

i. That, prior to construction of each of the local protection projects, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the projects; provide necessary relocations and alterations to highways, roads, and bridges; relocate and adjust all utilities; and construct necessary interior drainage ditches.

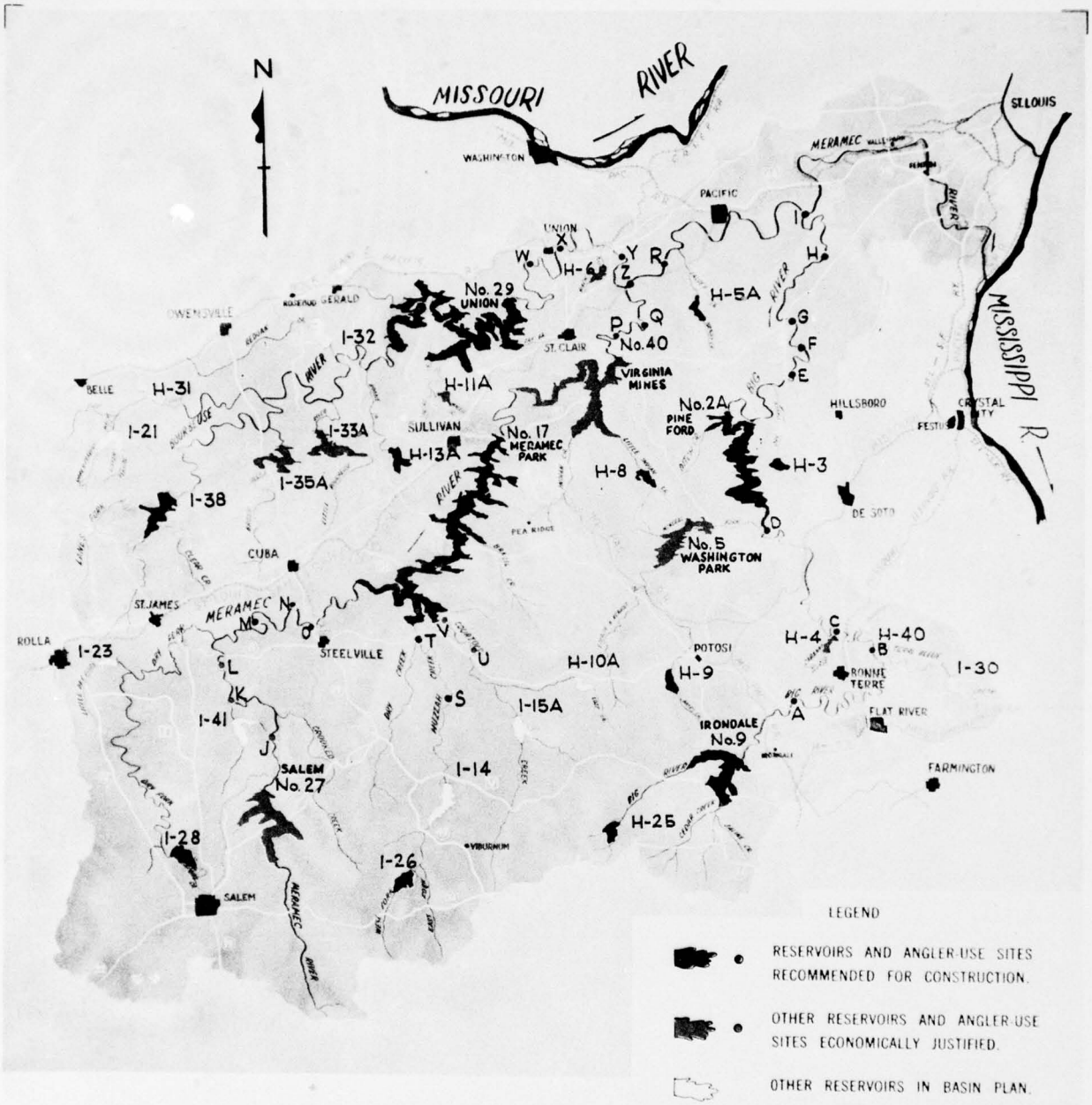
(2) Hold and save the United States free from damages due to the construction works.

(3) Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of the Army.

(4) Prevent encroachment on improved channels and ponding areas, and, if ponding areas and capacities are impaired, provide substitute storage capacity or equivalent pumping capacity promptly without cost to the United States.

j. That the reservoirs in the comprehensive plan designated as Washington Park, Virginia Mines, Salem, I-33A, and I-35A be authorized for site preservation, and that sufficient site investigations and designs be made for the purpose of defining the general project lands required, provided that responsible non-Federal interests give assurances acceptable to the Secretary of the Army that they will protect such lands by zoning or by the acquisition of such title to such lands as may be required to preserve the sites against incompatible developments.

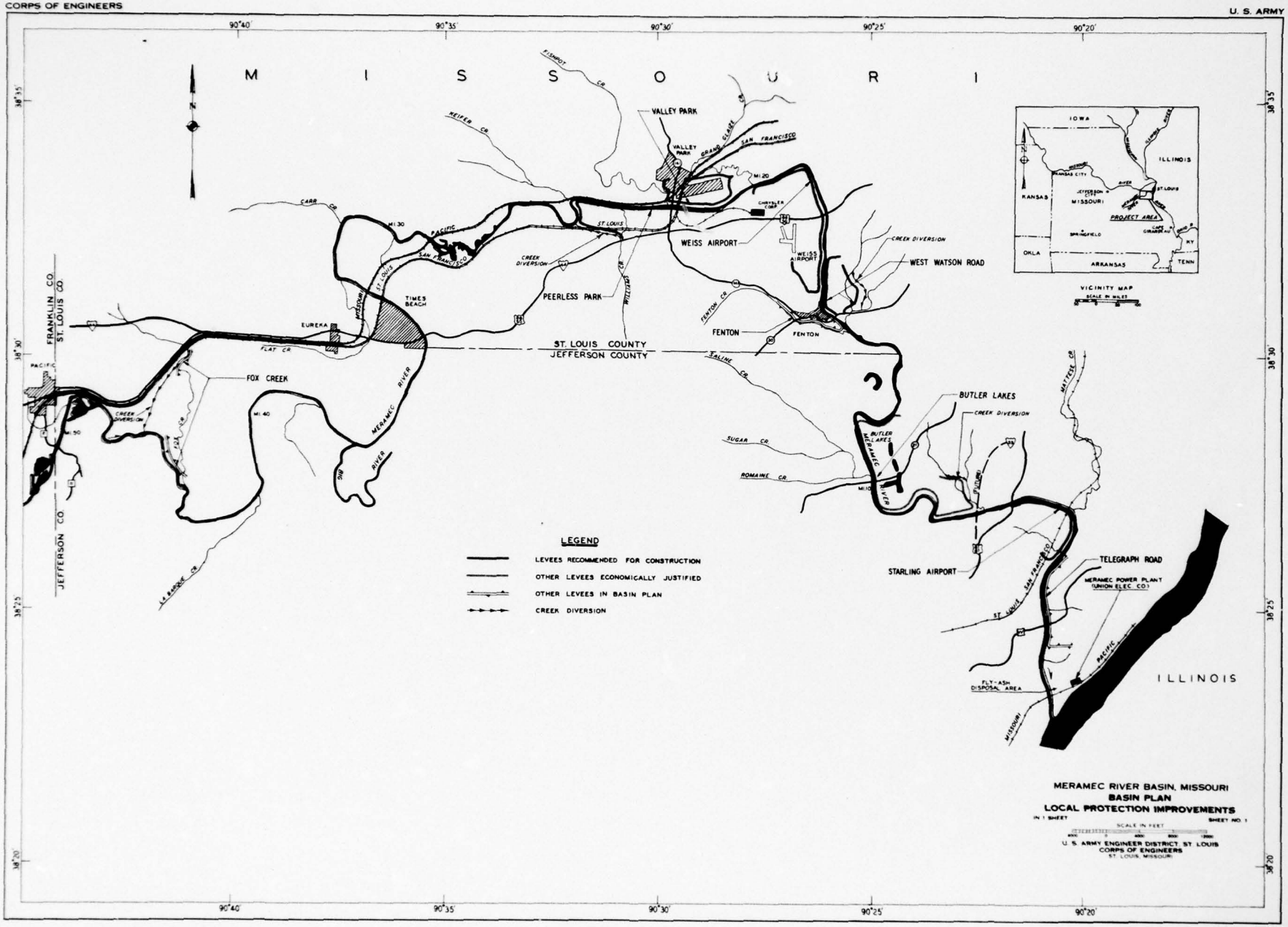
k. That the general comprehensive plan for flood control and other purposes in the upper Mississippi River Basin, approved by the Flood Control Act of 28 June 1938, be modified by deleting therefrom the reservoirs in the Meramec River Basin.



MERAMEC RIVER, MISSOURI
BASIN PLAN

CORPS OF ENGINEERS

U. S. ARMY



MERAMEC RIVER BASIN, MISSOURI

BASIN PLAN

LOCAL PROTECTION IMPROVEMENTS

IN 1 SHEET SHEET NO. 1

SCALE IN FEET

0 400 800 1200

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

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Information called for by Senate Resolution 148 (at end of report)

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
420 LOCUST STREET
ST. LOUIS 2, MISSOURI 63102

ADDRESS REPLY TO
DISTRICT ENGINEER
REFER TO FILE

LMLED-PE

30 January 1964

SUBJECT: Meramec River, Missouri - Comprehensive Basin Study

THRU: Division Engineer
U. S. Army Engineer Division, Lower Mississippi Valley

TO: Chief of Engineers

SECTION I - INTRODUCTION

1. AUTHORITY

This report is submitted in compliance with the following Congressional Committee resolution, dated 6 April 1960:

> "Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Meramec River, Missouri, published in House Document Numbered 686, 71st Congress, and other reports, with a view to determining whether the existing project for the Meramec River Basin should be modified in any way at the present time in the interest of flood control, water conservation, navigation, and other purposes. Cooperation, as required by law and regulations, with other Federal agencies will be appropriate. The study shall be coordinated with and will take into account the plans of the Meramec Basin Corporation in matters of Federal interest in the basin."

2. PAST HISTORY AND PRIOR REPORTS

A report on the Meramec River, published in 1930 as House Document No. 686, recommended no improvement in the Meramec Basin at that time

because of lack of economic justification. Later reports which summarized the "308" studies in the Missouri, Upper Mississippi, and Ohio River Basins resulted in a plan authorized by Congress in 1938, which included reservoirs in the Meramec River Basin as part of a system to reduce flooding on the Mississippi River. A detailed plan for the Meramec Basin, consisting of three reservoirs, was prepared in 1949. Due to lack of general public acceptance, the plan was deferred for further study.

3. PURPOSE AND SCOPE

This report is a review investigation made to determine the general scale, features, and functions of the most suitable comprehensive plan for ultimate development of the water and related land resources of the Meramec River Basin; the features most urgently needed for development of the ultimate plan; the economic justification of such features; and the extent of Federal and non-Federal participation therein. The guidelines established by Senate Document No. 97, 87th Congress, have been closely followed. The study reflects the views and interests of all water users, as these are represented by public agencies at all levels of government and by private organizations, where such agencies reflect the public interest in resources management. The scope of the study includes establishment of trends of economic growth which would permit identification of specific future problems of the area as they are related to the use and development of water and land resources. Activities of the Corps of Engineers in the preparation of this report included, but were not limited to, reservoir site reconnaissance surveys, damsite cross section surveys, foundation investigations, flood damage surveys, hydrology studies, design analyses, relocation studies, economic investigations, and over-all coordination with the Meramec Basin Corporation and governmental agencies having an interest in the project development. The District Engineer made a field and air reconnaissance of the basin. The following agencies participated in this study.

a. Federal agencies.

(1) The Department of Agriculture is engaged in a continuing study, under separate authority, to develop a watershed protection and management program for the basin. The plan of work for this study is presented in APPENDIX H. The Soil Conservation Service and the U. S. Forest Service have cooperated in the Corps of Engineers' study by furnishing an interim report on land use and capability and forest resources, and have furnished designs and cost estimates for a limited

number of headwater reservoir sites considered in this report as compatible with probable locations of larger downstream reservoirs studied.

(2) The Department of Health, Education, and Welfare. The Public Health Service made studies of the needs for water supply and water quality control. As a basis for determining these water needs, an economic base study was made, in cooperation with various other agencies, which provided data within their own particular fields of interest.

(3) The Department of the Interior.

(a) The U. S. Geological Survey provided data on stream flow and assisted in the groundwater study and in collecting water quality information.

(b) U. S. Fish and Wildlife Service evaluated the effects of water resource development on the basin's fish and wildlife resources and recommended measures to insure the greatest benefits to these resources, both in and below potential reservoirs, and estimated monetary values of such benefits.

(c) Bureau of Outdoor Recreation and National Park Service have determined the recreation needs and how these needs would be satisfied by the reservoir system formulated. The Bureau prepared attendance and benefit estimates, and the Park Service determined land and facilities requirements for ultimate development and estimates of annual operation and maintenance costs.

(d) Bureau of Mines evaluated the impact of the reservoir system on the mining industry and has projected the impact of the industry on the economy of the basin and its water resources.

(e) Southwestern Power Administration has analyzed the various hydroelectric power plans studied to determine whether the power produced could be marketed at the indicated cost and load factors.

(4) The Federal Power Commission furnished power value estimates and area-load-duration curves and worked with the Corps in studies of hydroelectric power potential.

(5) The Department of Commerce, Area Redevelopment Administration has assisted in developing data whereby project benefits from economic development of the area could be evaluated as to their effects on unemployment in areas designated eligible for ARA assistance.

b. State agencies.

(1) The Water Resources Board. This agency has a two-fold function. The Board is charged with the development of water and other economic resources of the State. The Governor appointed the Chairman of the Board as Chairman of an Advisory Committee to present to him the views of State agencies having an interest in the report of the Corps of Engineers.

(2) The Missouri Division of Geological Survey and Water Resources. The State Geologist has actively assisted the Corps in collecting and furnishing geological data throughout the basin. The Division has also furnished a report on groundwater use and production capabilities.

(3) The State Park Board. The Board has cooperated with the National Park Service in planning recreation developments to be installed at various reservoirs under study.

(4) The Water Pollution Board. The Board initiated a stream survey in the Meramec Basin and has collected data in the field with a portable laboratory.

(5) The State Highway Commission. The Commission has reviewed the road relocation plans of the Corps of Engineers.

(6) The Conservation Commission. The Commission has assisted the U. S. Fish and Wildlife Service in its current study of the Meramec River Basin.

(7) The Division of Commerce and Industrial Development. The Division has assisted the Corps of Engineers in evaluating the economic impact of the proposed plan of improvement on the commerce and industry of the basin.

(8) The University of Missouri Extension Service. The Extension Service is presently assisting local groups in organizing so that they may effectively support zoning, urban affairs, and allied concepts which are related to water resources development.

4. ROLE OF THE MERAMEC BASIN CORPORATION

a. Purpose. The Meramec Basin Corporation, incorporated in June 1958, is a non-profit Missouri corporation composed of 75 board members, representing widely diverse and civic-minded interests from the basin and the St. Louis metropolitan area. Most of this membership is from outside the metropolitan area. As quoted from the articles of incorporation, the Corporation has the following purposes:

> "To conduct a program of research on the resources of the Meramec Basin of Missouri and adjacent areas -- especially those resources related to water -- through the use of the best scientific methods and trained, unbiased technical personnel by universities and colleges, and other similar institutions and private and public agencies who can contribute to such an objective -- to the end of developing a hitherto, undiscovered or unused method of proper assessment of the resources and related problems of a region, as a guide for the use thereafter by the people of such an area, and other agencies and groups, in the development of the Meramec or other areas for the general welfare of local communities, the state and nation;
>
> "To conduct a program of public education, particularly in the Meramec Basin of Missouri, concerning the presence, the absence, the quality, and abundance of all types of resources -- natural and man-made -- and the problems attached thereto; to the end of providing sound and accurate information to the public for its proper enlightenment as to the facts and problems connected to the general progress of the region, and in doing this to provide a specific program through printed information, talks, films, forums, meetings, workshops, short courses, demonstrations, newspapers, radio, television, and any other suitable method for the individual citizen, civic, educational, and scientific groups of all kinds, schools, youth groups, and any interested individual or organization;
>
> "To continue to be of service -- in the fields of technical and scientific research, and public education -- on the continuing problems of development based on the resources of an area, particularly of the Meramec Basin."

b. Research Project. The responsibility of the Meramec Basin Corporation for research was focused initially through the Meramec Basin Research Project, set up as an independent study group in 1959 at Washington University through the sponsorship of the Corporation and the University. The report of the research group was published, in three volumes, between February 1962 and February 1963, and has been used extensively for reference and information herein. Federal and State agencies contributed to the study. While some planning features were discussed, the study report, in the words of Dr. Edward L. Ullman, the study director, examined the Meramec Basin "to provide a basis for economic development and proper planning, with particular emphasis on water resource problems, demands, and opportunities." He also stated that "the present report is a beginning, not an operating conclusion, although some definite recommendations and their consequences are indicated."

c. Extent of use of Research Project report. Volumes II and III of the Research Project report have been accepted as the economic base study for this report and are presented as APPENDIX A and APPENDIX B, respectively. This report has been used by the Public Health Service as a source of basic data for economic and population projections to determine the need for water supply and water quality control. The recreation agencies contributing to this report have also used it together with other data in projecting the recreation needs. Flood Plain Land Use Maps contained in CHAPTER 2, APPENDIX B, were used in determination of flood damages. Many of the illustrations used herein were furnished by the Meramec Basin Corporation from the Research Project report.

d. Cooperative Planning Committee. Among its responsibilities for continuing service, the Corporation has been the sponsor of the Meramec Basin Cooperative Planning Committee since January 1962. This committee is made up of area residents and State agency representatives, with cooperating Federal agencies serving in an active advisory capacity. The general basis for the committee is described as ". . . a means of effecting cooperative citizen-government participation in working out satisfactory answers on problems, in the Meramec Basin of Missouri, which have previously escaped solution." This committee, with several subcommittees, has functioned from its inception with the approval and cooperation of the Governor of Missouri, and is continuing its practical function in reviewing features of the plan of development and making recommendations with reference to local problems and effects, particularly toward the need for understanding

by basin residents of what is involved in planning regional and related developments. The views of the committee regarding the best plan of development that should be undertaken for the basin have been transmitted to the District Engineer.

e. Future responsibilities. The Meramec Basin Corporation visualizes that it will play a vital role as the project develops. One of the important aspects is the question of the form and practicability of assuring local participation in the sharing of cost. The Corporation plans to undertake a research study which will explore all possible means of achieving such required local sponsorship.

SECTION II - DESCRIPTION OF BASIN

5. LOCATION AND EXTENT

The Meramec River joins the Mississippi River on the right bank 160.6 miles above the mouth of the Ohio River, and is the first major tributary entering the Mississippi River below the mouth of the Missouri River. The basin lies wholly within the State of Missouri, contains 3,980 square miles, and comprises all or portions of 15 counties. See PLATE 1.

6. STREAMS

The drainage system consists of the Meramec River and its two principal tributaries, the Big River and the Bourbeuse River. These major streams follow tortuous routes, and their directions change abruptly in many places.

a. The Meramec River. This river has a drainage area of 2,164 square miles, exclusive of the Big and Bourbeuse River sub-basins, and a length of 220 miles. It rises in Dent County, flows in a northerly direction to a point near Maramec Spring, mile 168.8, then follows a general northeasterly course to the vicinity of Kirkwood, Missouri, near mile 19.0, where it turns toward the southeast to join the Mississippi River about 12 miles south of St. Louis, Missouri. It has a total fall of 1,025 feet with about half of this fall occurring in the uppermost 40 miles. The flood plain along its valley contains about 55,600 acres, of which 26,900 acres lie above the mouth of the Bourbeuse River at mile 64.8. An additional area estimated at 18,000 acres lies in the flood plains of the minor tributaries.

b. The Big River. In general, the Big River parallels the eastern boundary of the watershed, rising in the northern part of Iron County and joining the Meramec River at mile 37.5, about 3 miles upstream of Eureka. It has a drainage area of about 968 square miles and a length of 137 miles above its junction with the Meramec River. It has a total fall through its length of about 970 feet with a little more than half the total fall occurring in the uppermost 9 miles of the stream. The flood plain of the Big River consists of about 23,300 acres, with an additional 4,600 acres of flood plain along its tributaries.

c. The Bourbeuse River. The river has its source in Phelps County and follows a course generally parallel to the northern boundary

of the basin, entering the Meramec River at mile 64.8. The Bourbeuse River is about 145 miles in length and has a drainage area of about 848 square miles. It has a total fall of about 740 feet with about 50 percent of the over-all fall occurring in the uppermost 18 miles. The flood plain consists of about 22,300 acres along the main stream with an additional 5,600 acres along tributaries.

d. Minor tributaries. The tributaries of the Meramec and Big Rivers rise in the forested hills in the south and central parts of the basin and are generally clear. However, those of the Bourbeuse River flow through predominantly farm country in the north and are more turbid. Numerous large perennial springs, especially Maramec Spring near St. James, contribute to stream flow. However, some of the smaller streams become trickles or cease flowing in the drier periods.

7. TOPOGRAPHY

The basin lies on the northern flanks of the Ozarks, and the watershed includes portions of the Salem Plateau and St. Francois Mountain sections of the Ozark Plateau's physiographic province. The area is unglaciated and has been subjected to long periods of erosion resulting in at least partial peneplanation with the development of streams having meandering courses. Subsequent and repeated uplift caused the streams to carve deep valleys along their meandering paths. Some of the intervalley land is a high plateau of gently rolling topography and flatlands, highly contrasted to the generally rugged topography exhibited elsewhere in the basin. Although the area as a whole is not much higher than the rest of the State, a few hills in the Big River headwaters rise to elevations which are maximum for the Ozarks. Local relief averages between 200 and 400 feet. Bare rock hills, rock bluffs, and sparsely covered cedar glades are common in the uplands. On the slopes of the St. Francois Mountains at constricted gorges called "shut-ins", low waterfalls are developed. In general, the basin may be described as a highly dissected plateau, with the land surface sloping gently to the north and becoming increasingly more rugged toward the south. See FIGURE 1, TERRAIN.

8. GEOLOGY AND SOILS

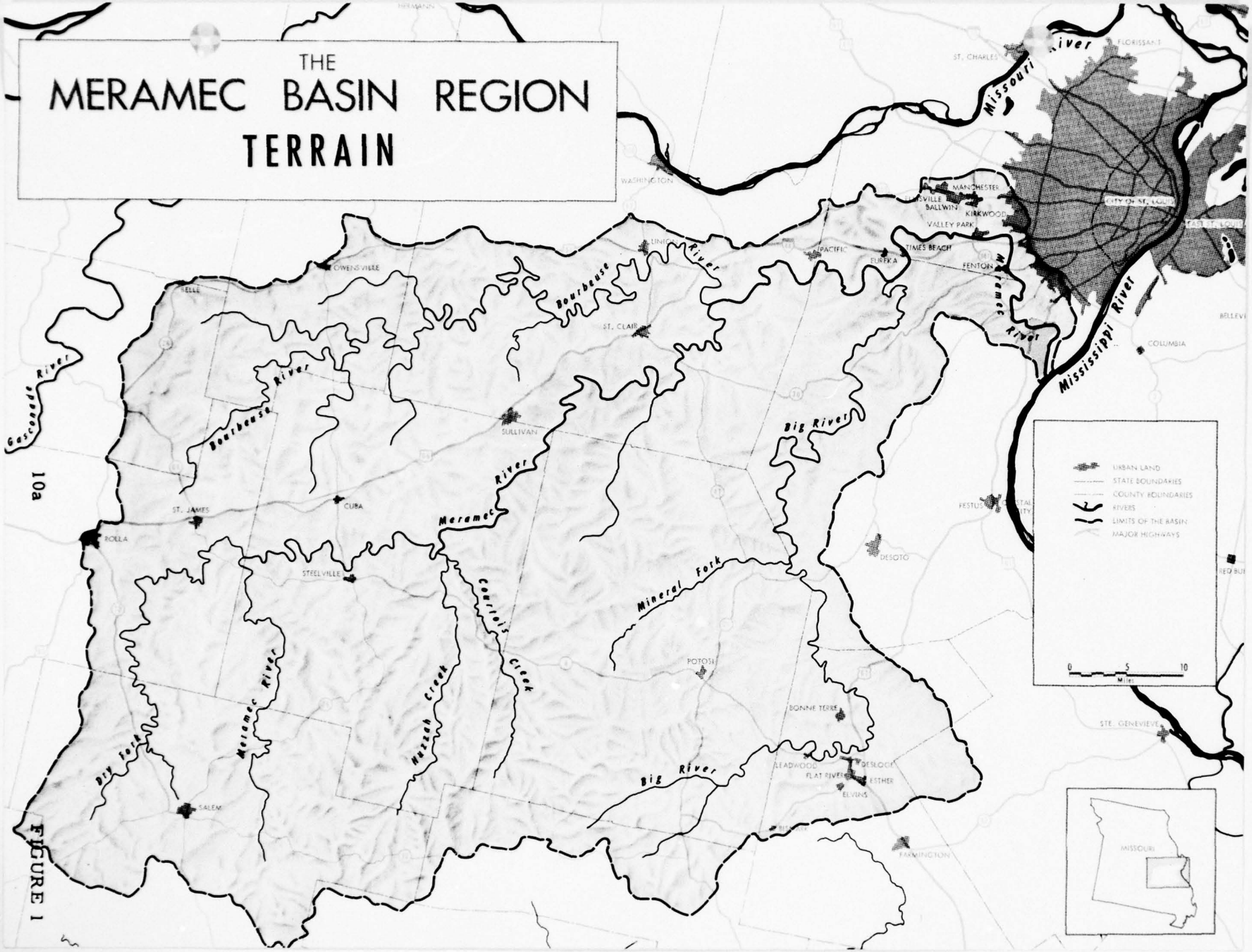
The rocks of the basin range from pre-Cambrian granites and felsites in the south, through the predominant Cambrian and Ordovician cherty dolomites to Mississippian sediments in the extreme east, and to Pennsylvanian clays and shales in the northern portions. These rocks dip more steeply away from the southern St. Francois Mountain

area than does the natural ground. Consequently, they are bevelled, and progressively younger formations are exposed to the north and northeast. This regional inclination is interrupted frequently by faults cutting across the rocks. Sink holes, dry valleys, caverns, springs, and related solution features are common and abundant in the cherty, carbonate rocks. See FIGURE 2, CAVES AND SPRINGS. The upland soils clearly exhibit the parent material, chert-filled, deep-red plastic clays from the cherty carbonates through light-gray plastic clays from the Pennsylvanian shales. Weathering produces residual soils varying from a few feet in thickness up to 50 or more feet, depending primarily on the rock type. The soft shales and sandstones of the northwest basin show the deepest weathering. The northern and northeastern rim of the basin has received a coat of loessial soils which have extensively modified the otherwise residual soil. Valleys show all ranges of alluvial soil types from gravel-choked streambeds to flood plains of stratified sands and gravels topped with silts and clay. With the exception of the soft Pennsylvanian sediments, most of the rocks of the basin have more than adequate strength characteristics for founding dam structures. Deficiencies in foundations would most commonly be encountered due to solution features, faulting, erratic and deep rock weathering, and closely spaced joint patterns. Suitable fill material is generally obtainable from these alluvial deposits. APPENDIX D contains additional data on geology and soils in relation to planned improvements.

9. CLIMATE, RAINFALL, AND RUNOFF

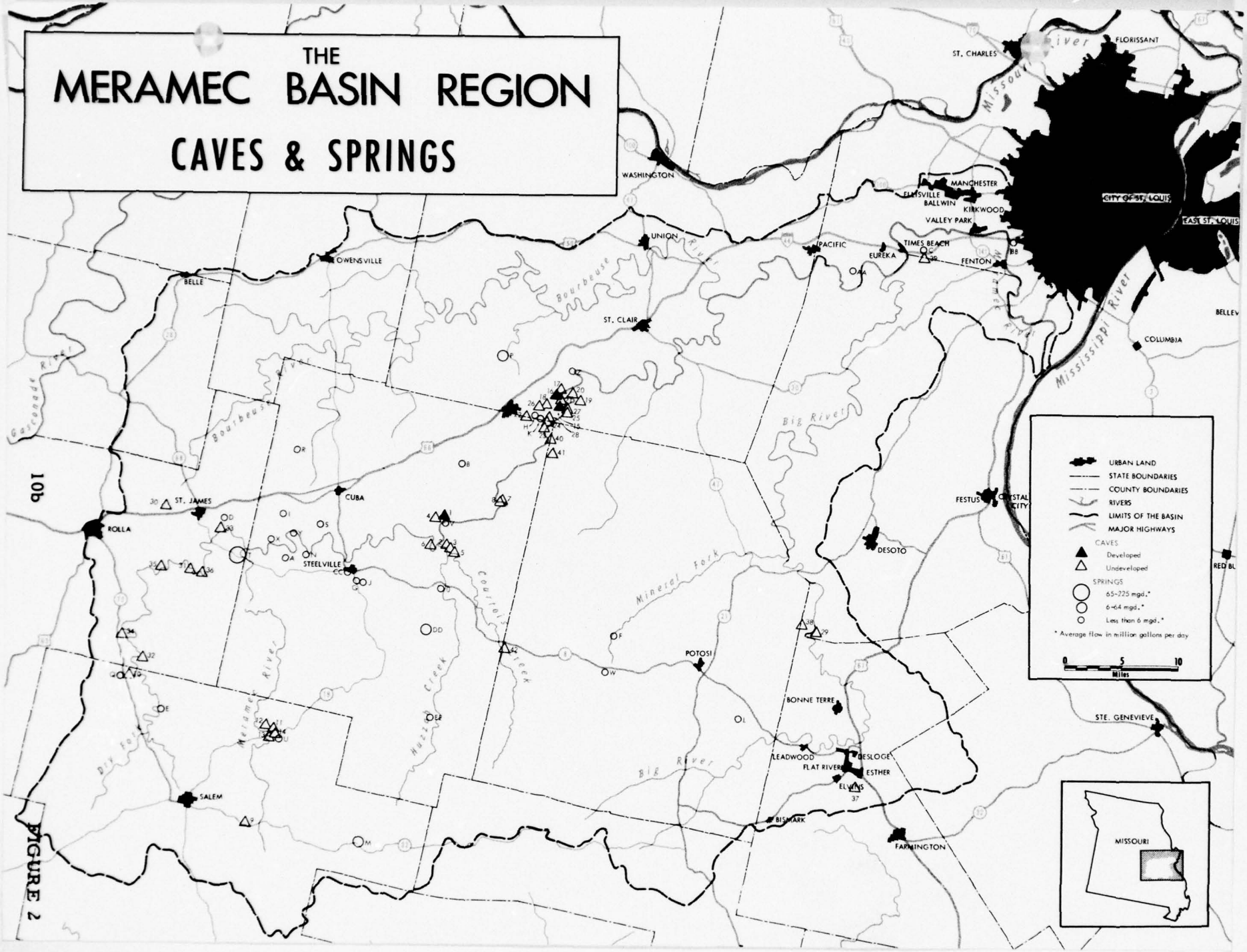
a. Climate. The climate is of the interior continental type in which temperatures cover a wide range in the daily, monthly, and seasonal values. The air masses that generally influence the climate move predominantly from the southwest, frequently bringing moisture-laden air from the Gulf of Mexico. At other times, it is the same southwesterly flow of air which brings in the hot, dry air from the desert southwest that results in drought conditions. Frequently in the winter months, cold Canadian air masses dip down and bring Arctic air into the basin. The average annual temperature is about 57° F. with extremes of -33° and 115° F. having been recorded in the basin.

b. Rainfall. The average annual rainfall for the basin as computed from 12 long-term stations is about 39 inches. The mean low is 35.44 inches and the mean high is 42.51 inches. The normal growing season is from mid-April to mid-October, and about 23 inches


THE
MERAMEC BASIN REGION
TERRAIN
Missouri River
Mississippi River
Gasconade River
Bourbeuse River
Meramec River
Big River
Mineral Fork
Courtois Creek
Huzzah Creek
Dry Fork
Meramec River
Big River
ST. CHARLES
FLORISSANT
WASHINGTON
MANCHESTER
KIRKWOOD
VALLEY PARK
CITY OF ST. LOUIS
PACIFIC
EUREKA
TIMES BEACH
FENTON
UNION
OWENSVILLE
ST. CLAIR
SULLIVAN
CUBA
ST. JAMES
ROLLA
STEELVILLE
SALEM
POTOSI
DESOTO
FESTUS
BONNE TERRE
LEADWOOD
FLAT RIVER
DESLOGE
ESTHER
ELVINS
FARMINGTON
STE. GENEVIEVE
COLUMBIA
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
0 5 10
Miles
MISSOURI

10a

FIGURE 1


THE
MERAMEC BASIN REGION
CAVES & SPRINGS
ST. CHARLES
FLORISSANT
WASHINGTON
MANCHESTER
ELLISVILLE
BALLWIN
KIRKWOOD
VALLEY PARK
CITY OF ST. LOUIS
EAST ST. LOUIS
UNION
PACIFIC
EUREKA
TIMES BEACH
FENTON
OWENSVILLE
BELLE
ST. CLAIR
COLUMBIA
CUBA
ST. JAMES
ROLLA
STEELVILLE
FESTUS
CRYSTAL CITY
DESOTO
POTOSI
BONNE TERRE
LEADWOOD
DESLOGE
FLAT RIVER
ESTHER
ELVINS
STE. GENEVIEVE
SALEM
BISMARK
FARMINGTON
Missouri River
Mississippi River
Bourbeuse River
Big River
Mineral Fork
Courtois Creek
Huzzah Creek
Meramec River
Dry Fork
Gasconade River
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
CAVES
Developed
Undeveloped
SPRINGS
65-225 mgd.*
6-64 mgd.*
Less than 6 mgd.*
* Average flow in million gallons per day
0 5 10
Miles
MISSOURI

10b

FIGURE 2

of rainfall or 59 percent of the annual total falls in this period. The greatest deviation from the mean usually occurs during the months of July and August, with the possibility of extremely heavy rainfall or extreme drought conditions. Snowfall is usually limited to the period from October to April and seldom covers the ground for long periods. Average annual snowfall is about 16 inches.

c. Runoff. General storms with heavy rainfall extending for several days have produced the most noticeable runoff. Relatively slow infiltration results in a high rate of runoff, and the steep topography allows runoff to reach the main streams quickly. The furthermost downstream gages on the Meramec, Big, and Bourbeuse Rivers are at Eureka, Byrnesville, and Union, respectively. The extremes and average flows in cubic feet per second recorded at each of these stations are shown in TABLE 1. The greatest known discharge at Eureka, 175,000 c.f.s., occurred in 1915, and the lowest of record, 196 c.f.s., occurred in 1936. The runoff from the 1915 flood at Eureka amounted to 5.32 inches over the upstream area, or almost 50 percent of the average annual runoff at this point. The maximum monthly runoff at Eureka for the period of record was 22,600 c.f.s. and occurred in April 1927, while the minimum monthly runoff of 236 c.f.s. occurred in October 1956. The long-term average monthly runoff at Eureka ranged from a maximum of 6,026 c.f.s. in April to a low of 1,114 c.f.s. in September. The average annual runoff at Eureka is equivalent to 11 inches of rainfall over the upstream drainage area. Additional information is contained in APPENDIX C.

TABLE 1
Stage and discharge data
(for period of record)

Station	River	Mile above mouth	Drainage area sq. mi.	Gage zero ft., m.s.l.	Maximum Stage ft.	Maximum Discharge c.f.s.	Maximum Date	Minimum Stage ft.	Minimum Discharge c.f.s.	Minimum Date	Mean flow c.f.s.(2)
Eureka	Meramec	34.6	3,788	406.18	36.94	175,000(1) 120,000	1915 11 Jun 45	0.34	196	27 Aug 36 31 Aug 36 1 Sep 36	3,110
Sullivan	Meramec	113.2	1,475	581.82	32.00	77,300	9 Jun 45	1.27	131	20 Sep 56 22 Sep 56	1,221
Byrnesville	Big	14.1	917	433.69	26.41	80,000(1) 42,100	1915 1 Jul 57	1.50	25	30 Aug 36	858
Union	Bourbeuse	13.4	808	488.58	24.44	50,000(1) 33,100	1915 1 Jul 57	0.59	11	10 Oct 56	659

(1) Maximum flood but not included in period of record.
(2) Through 1959.

(1) Major floods. A major flood in the Meramec Basin is one that is generally widespread with stages at Valley Park, mile 22 above mouth of Meramec River, reaching approximately 30 feet. Flood stage at this station is considered to be 16 feet. Listed in TABLE 2 are the major floods and stages at Valley Park. Although the flood in 1957 registered a stage of 32 feet at Valley Park, flooding in the upper reaches of the tributary system was not as widespread as the other floods. The storm causing this flood was centered over the lower portion of the basin.

TABLE 2
Major floods

Occurrence		Stage at
Month	Year	Valley Park
Aug	1915	37.8
Feb	1916	34.4
Jun	1945	33.0
Jul	1957	32.0
Mar	1904	31.1
Mar	1913	30.8
Oct	1919	30.7
Jan	1950	30.0
Dec	1942	28.7

Complete data are not available for the years 1904, 1913, 1916, and 1919, but crest stages at Valley Park are a matter of record.

(2) Droughts. Low flows occur regularly within the Meramec Basin for periods of 1 to 8 months, but these periods generally cause only minor inconvenience and damage in restricted areas. Study of streamflow records for the past 40 years from the Eureka, Byrnesville, and Union gages indicates that, while each station may have periods of low flow not in common with the others, they do have in common five prolonged periods of low flow. These periods are 1930-31, 1933-34, 1939-41, 1952-55, and 1955-57. By far the most severe period for duration, as well as accumulated deficiency, was that for 1952-55. Furthermore, with a break of only 1 to 2 months, this drought continued until January 1957. Flows at Eureka for the combined 1952-55 and 1955-57 periods were only 39 percent of the long-term monthly average for a period of 1,737 days. The accumulated deficiency amounted to 6,315,732 acre-feet of run-off at Eureka.

10. MAPS

Investigations for this report are based principally on maps published by the U. S. Geological Survey, Department of the Interior. These maps are available for the entire basin area. Maps published in the early part of 1900 are to a scale of 1 to 62,500 and later maps are to a scale of 1 to 24,000. Reservoir maps were prepared from these maps and aerial photos of the basin area. The aerial photos, which were obtained from the Eastern Aerial Photography Laboratory, U. S. Department of Agriculture, were prepared during the period 1954 to 1959. An aerial mosaic of the basin was prepared from these photos by the Corps of Engineers. County and State road maps were utilized in the relocation studies. Topographic surveys of damsites at Meramec Park and Union, which were prepared for the definite project studies in 1949, were utilized for these sites.

SECTION III - PRESENT ECONOMIC DEVELOPMENT

11. POPULATION

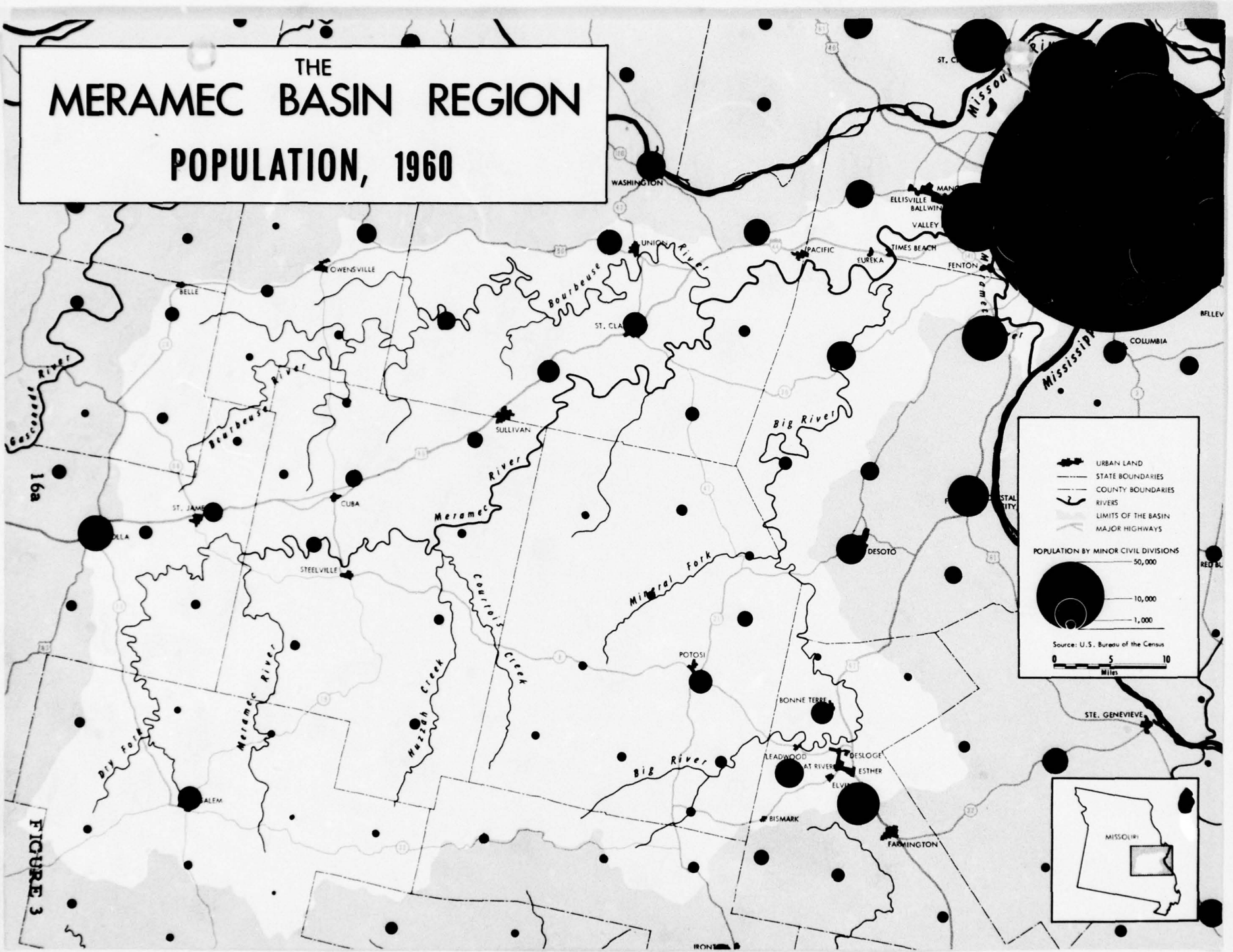
The 1960 population of the basin was approximately 212,000, of which almost one-half was in the St. Louis Metropolitan Statistical Area. The St. Louis Metropolitan Statistical Area in 1960 comprised the city of St. Louis, St. Louis County, St. Charles County, and Jefferson County in Missouri; and St. Clair and Madison Counties in Illinois. The remainder of the population is scattered throughout the basin. Although the central and southern counties of the basin lost population between 1950 and 1960, most counties, including those close to St. Louis, gained in population. This gain was in sharp contrast to the trend for Missouri as a whole, where some 88 counties lost and only 26 counties gained, although the State as a whole showed an increase in population of about 8 percent. In those counties which had an over-all gain in population, increases were primarily in the larger towns rather than in the rural areas. The population per square mile in the Meramec Basin ranges from 131 in St. Louis County to 14 in Maries and Dent Counties. The average population density is 53 persons per square mile. See FIGURE 3, POPULATION, 1960. Historical data on population of the United States as compared with the Meramec River Basin and the St. Louis Metropolitan Statistical Area are shown in TABLE 3.

TABLE 3
Population
United States, Meramec River Basin, and
St. Louis metropolitan area

	Population (thousands)			Average annual change (percent)			Percent of U. S. total	
Year	United States	Meramec River Basin	St. Louis met. area	United States	Meramec River Basin	St. Louis met. area	Meramec River Basin	St. Louis met. area
1910	92,700	121	1,032	---	---	---	0.13	1.11
1920	106,800	115	1,166	+1.43	-0.50	+1.23	0.11	1.09
1930	123,600	108	1,387	+1.47	-0.61	+1.75	0.087	1.12
1940	132,100	122	1,464	+0.67	+1.23	+0.54	0.092	1.11
1950	151,700	141	1,719	+1.39	+1.46	+1.62	0.093	1.13
1960	180,700	212	2,060	+1.76	+4.16	+1.83	0.12	1.14

12. LAND USE

There are approximately 2,547,000 acres within the Meramec River Basin, of which 62 percent is in timberland, 35 percent is in cropland and pasture, and the remaining 3 percent is in other use. See FIGURE 4, LAND USE, and APPENDIX A. The gently rolling terrain to the north and the narrow alluvial valleys throughout the basin are predominantly agricultural. Southward the land becomes more rugged and heavily wooded. There are 396,000 acres in the south central portion of the basin which lie within the boundaries of the Clark National Forest and are under multiple-use management for wildlife, forests, water, and recreation. Nine percent of the total area within the basin is under State or Federal ownership. Approximately 5 percent of the total area of the basin lies within the flood plains. About 61 percent of the bottom land is in crops and pasture, 36 percent in timberland and other uses, and 3 percent in urban or recreational use. Most of the urban and recreational use areas are concentrated downstream from the town of Pacific, mile 49 above the mouth of the Meramec River. The recreational use facilities in these areas consist primarily of week-end dwellings, locally referred to as "clubhouses". In general, these dwellings are of economical-type construction with living quarters built well above the more frequent flood levels. Land use distribution in the flood plains is shown in TABLE 4.


THE
MERAMEC BASIN REGION
POPULATION, 1960
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
POPULATION BY MINOR CIVIL DIVISIONS
50,000
10,000
1,000
Source: U.S. Bureau of the Census
0 5 10
Miles
MISSOURI
WASHINGTON
UNION
PACIFIC
EUREKA
TIMES BEACH
FENTON
COLUMBIA
OWENSVILLE
BELLE
SULLIVAN
CUBA
STEELVILLE
DESOTO
POTOSI
BONNE TERRE
LEADWOOD
DESLOGE
ESTHER
FARMINGTON
BISMARK
STE. GENEVIEVE
SALEM
Bourbeuse River
Big River
Meramec River
Mineral Fork
Courtois Creek
Huzzah Creek
Dry Fork
Gasconade River
Mississippi River
Missouri River

16a

FIGURE 3

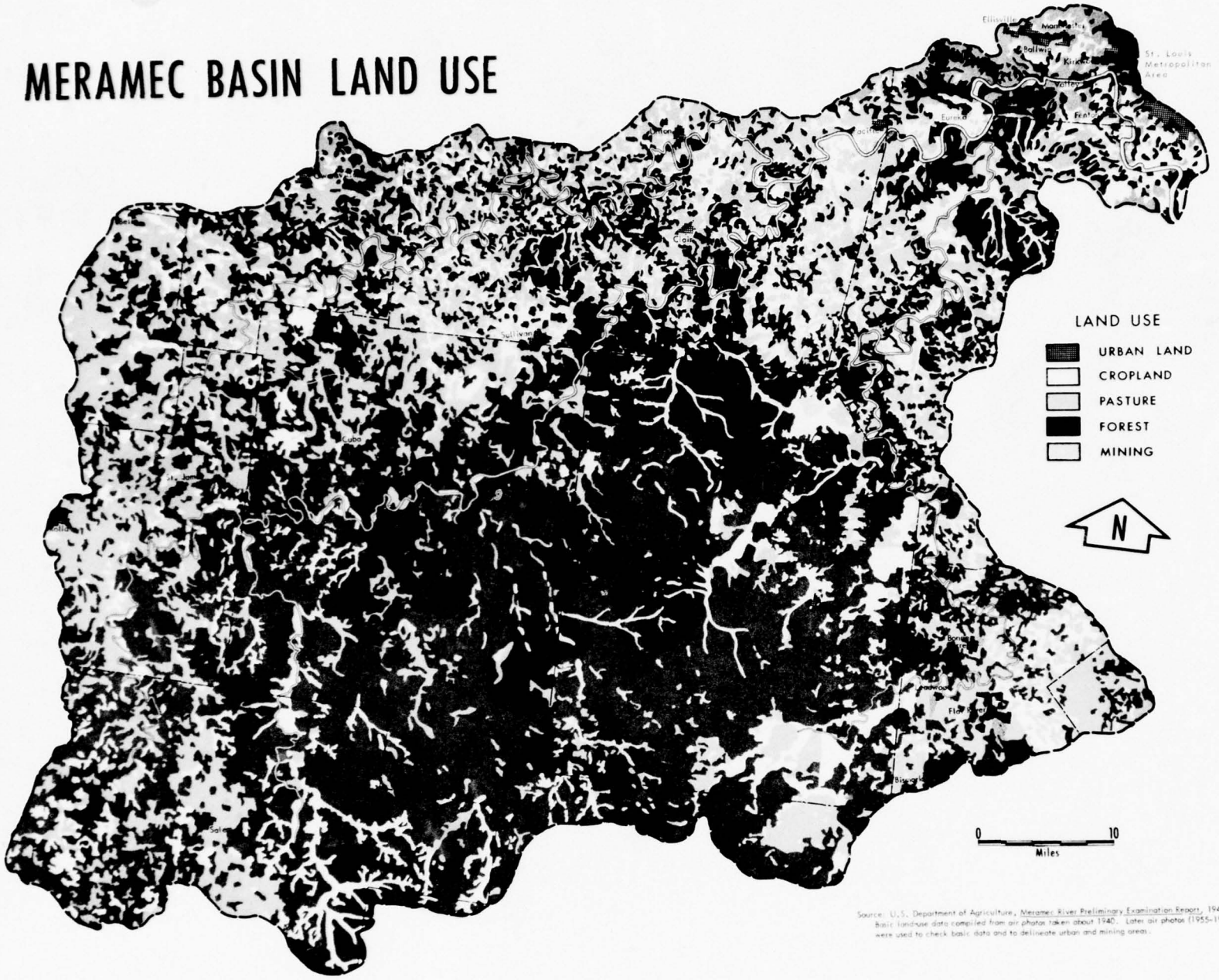

MERAMEC BASIN LAND USE
LAND USE
URBAN LAND
CROPLAND
PASTURE
FOREST
MINING
N
0
10
Miles
St. Louis Metropolitan Area
Source: U.S. Department of Agriculture, Meramec River Preliminary Examination Report, 1942. Basic landuse data compiled from air photos taken about 1940. Later air photos (1955-1959) were used to check basic data and to delineate urban and mining areas.

FIGURE 4

16b

TABLE 4
Land use distribution in flood plains

Land use	Meramec River											
	Below Big River	Big River to Bourbeuse River	Above Bourbeuse River	Meramec River tributaries	Total, Meramec and tributaries	Big River	Big River tributaries	Total, Big River and tributaries	Bourbeuse River	Bourbeuse River tributaries	Total, Bourbeuse River and tributaries	Grand total, flood plain
Crops and pasture												
(acres)	9,070	7,390	14,440	13,490	44,390	14,650	3,150	17,800	12,490	4,580	17,070	79,260
(percent)	53	63	54	75	61	63	69	64	56	82	61	61
Urban and recreation												
(acres)	2,240	310	580	90	3,220	470	20	490	100	0	100	3,810
(percent)	13	3	2	0*	4	2	0*	2	0*	0	0*	3
Forest and other												
(acres)	5,830	3,920	11,860	4,410	26,020	8,150	1,420	9,570	9,770	1,000	10,770	46,360
(percent)	34	34	44	25	35	35	31	34	44	18	39	36
Total												
(acres)	17,140	11,620	26,880	17,990	73,630	23,270	4,590	27,860	22,360	5,580	27,940	129,430
											Say	129,400
(percent)	100	100	100	100	100	100	100	100	100	100	100	100

*Percentages are zero when rounded to the nearest 1 percent.

13. AGRICULTURE

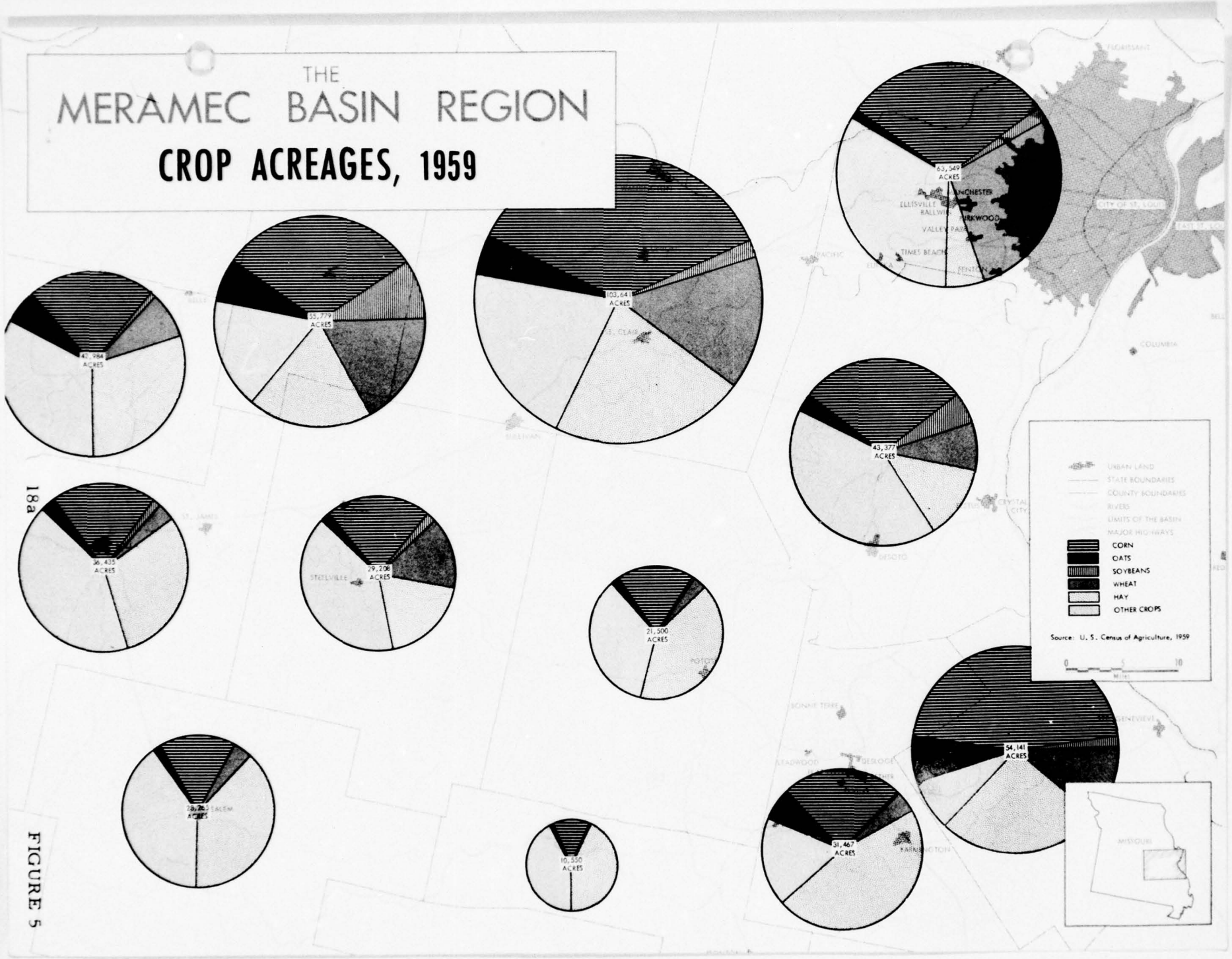
Excluding St. Louis County, about 25 percent of the basin's labor force is engaged in agricultural pursuits. In the central and southwestern counties, agriculture employs about 30 percent of the total labor force. Although the number of farms in the basin has declined since 1930, the size of individual operating units has increased. In contrast to other parts of the basin, farming acreage in the bottom lands has increased slightly since 1930. At the present time, the average size of farms in the Meramec Basin is approximately 300 acres.

a. Crops. Crop production is principally for a livestock economy. The principal crops grown are corn, wheat, soybeans, oats, alfalfa, lespedeza, clover, and fescue. See FIGURE 5, CROP ACREAGES, 1959. The basin depends principally upon the flood plains to produce the major portion of the grain and hay needed for livestock feeding. The soils in the bottoms are fertile, well drained, and easily tilled. Other basin soils are suitable mostly for timber and pasture rather than crops. Therefore, the bottom lands are the "life blood" of the farm, and, as such, are intensively cultivated with resulting high yields. Yields have risen to two to three times what they were in 1930. Comparative average yields are shown in TABLE 5. See PART I, APPENDIX G, for data on land capability.

TABLE 5
Average 1961 crop yields

	United States	Missouri	Meramec Basin*	Meramec Basin flood plain
Corn (bu/ac)	61.8	62.0	57.3	70-90
Wheat (bu/ac)	23.9	30.5	29.0	30-35
Soybeans (bu/ac)	16.5	24.5	21.6	30
Oats (bu/ac)	42.2	35.0	36.0	--
All hay (tons/ac)	1.74	1.70	1.80	2.5 to 3.5

*The average yields shown are for the eight basin counties which have a significant amount of land in the flood plain downstream from the reservoirs considered. These counties include Washington, Crawford, St. Louis, Jefferson, Franklin, Gasconade, St. Francois, and Phelps Counties.


THE
MERAMEC BASIN REGION
CROP ACREAGES, 1959
42,984 ACRES
65,779 ACRES
103,641 ACRES
63,549 ACRES
43,377 ACRES
36,435 ACRES
29,208 ACRES
21,500 ACRES
54,141 ACRES
31,467 ACRES
10,550 ACRES
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
CORN
OATS
SOYBEANS
WHEAT
HAY
OTHER CROPS
Source: U. S. Census of Agriculture, 1959

18a

FIGURE 5

b. Livestock. Of all farm products sold in 1959, livestock products accounted for approximately 70 percent of the total. The value of farm products sold for those counties having more than 20 percent of their area within the basin* is shown in TABLE 6.

TABLE 6
Value of farm products sold

Year	All crops ($1,000)	All livestock and livestock products ($1,000)	Forest products and horticulture specialty products ($1,000)	All farm products ($1,000)
1949	8,646	27,830	329	36,805
1954	8,299	24,388	195	32,882
1959	11,267	33,961	3,635	48,863

14. INDUSTRIES

a. Forestry. There are 1.5 million acres of forest land in the Meramec River Basin best suited to producing tree crops. About 24 percent of the forest area is in saw timber, 40 percent in pole timber, and 15 percent in seedlings and saplings. The remainder is not adequately stocked. The majority of the forest land is privately owned. The principal wood products produced in the basin are railroad cross ties, flooring, charcoal, barrel staves, posts, poles, tool handles, and lumber. Approximately 27 million board feet of saw timber is cut annually in the Meramec River Basin, of which approximately half is made into hardwood flooring. Charcoal is next in importance as a wood product. The total sales of wood and wood products at plants in the Meramec Basin in 1960 amounted to approximately $9 million. The value of timber supplied by landowners was about 40 percent of this figure. Forestry occupation does not account for a large percentage of the total employment in the basin. Approximately 600 persons find full- or part-time work in timber resource industries. The annual payroll is approximately $2.3 million, with an additional $3.7 million paid to landowners and loggers supplying wood to processing plants.

b. Mining. This industry, once the dominant activity in the Meramec Basin, has declined in recent years. In 1960, mining

*Crawford, Washington, Dent, Franklin, Jefferson, Phelps, St. Francois, Gasconade, St. Louis, Maries, and Iron Counties.

activities employed a relatively small proportion of the basin's inhabitants. Over the last 10 years, the Meramec Basin accounted for about 36 percent of the total value of minerals produced in the State. See FIGURE 6, MINING AREAS. The value of mineral production in the basin has ranged from a high of $63,050,000 in 1956 to a low of $48,208,000 in 1961. TABLE 7 shows the relation of the Meramec Basin to the total value of mineral output of the State of Missouri.

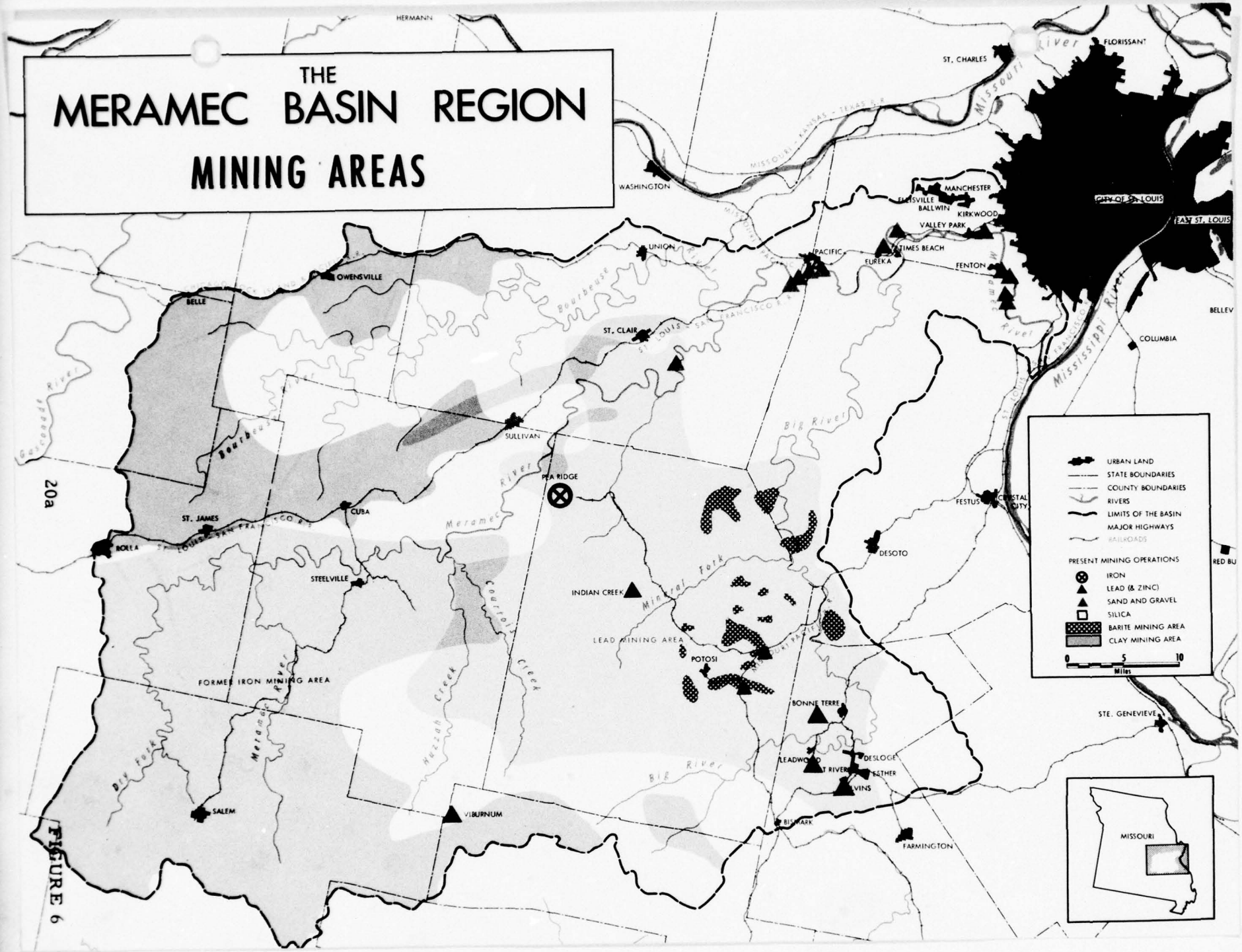
TABLE 7
Comparison of the value of mineral production in the Meramec Basin and State of Missouri, 1952-1961

Year	Meramec Basin	Missouri	Meramec Basin as percent of Missouri
1952	$56,042,083	$140,249,000	40.0
1953	50,453,694	128,207,000	39.4
1954	53,366,168	136,288,000	39.2
1955	60,211,426	157,588,000	38.2
1956	63,050,526	170,113,000	37.1
1957	57,563,380	159,209,000	36.2
1958	48,504,508	150,538,000	32.2
1959	51,460,002	164,025,000	31.4
1960	51,781,706	162,244,000	31.9
1961	48,208,556	151,288,000	31.9

(1) Lead. The "lead belt", located in the southeastern part of the basin, has been the major source of domestic lead for over 50 years. In 1960, the basin produced 42 percent of the total U. S. output, valued at $23 million. Zinc, copper, silver, cobalt, nickel, and cadmium are also recovered from the lead mining operation.

(2) Barite. Missouri ranks second to Arkansas in quantity of barite produced, but ranks first in value of production because of the high grade of ore marketed. In 1961, 238,000 tons of barite, valued at $3.2 million, were produced in the Meramec Basin. Yearly output was highest in 1956 when 382,000 tons, valued at $4.5 million, were mined.

(3) Iron. In November 1962, there was one producing iron ore mine a few miles outside the basin boundary and one major


THE
MERAMEC BASIN REGION
MINING AREAS
HERMANN
WASHINGTON
ST. CHARLES
FLORISSANT
MISSOURI
MISSISSIPPI River
CITY OF ST. LOUIS
EAST ST. LOUIS
MANCHESTER
FLEISSVILLE
BALLWIN
KIRKWOOD
VALLEY PARK
TIMES BEACH
EUREKA
PACIFIC
FENTON
UNION
OWENSVILLE
BELLE
ST. CLAIR
SULLIVAN
Bourbeuse River
Gasconade River
Big River
COLUMBIA
BELLEV
PEA RIDGE
CUBA
ST. JAMES
ROLLA
Meramec River
STEELVILLE
FESTUS
CRYSTAL CITY
DESOTO
RED BU
INDIAN CREEK
Mineral Fork
LEAD MINING AREA
POTOSI
FORMER IRON MINING AREA
Dry Fork
Huzzah Creek
Courtois Creek
BONNE TERRE
STE. GENEVIEVE
LEADWOOD
DESLOGE
ESTHER
ELVINS
SALEM
VIBURNUM
BISMARK
FARMINGTON
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
RAILROADS
PRESENT MINING OPERATIONS
IRON
LEAD (& ZINC)
SAND AND GRAVEL
SILICA
BARITE MINING AREA
CLAY MINING AREA
0 5 10
Miles
MISSOURI

20a

FIGURE 6

iron ore mine being developed at Pea Ridge in the basin. The former mine is now mining and upgrading about 2,000 long tons of iron ore per day. In 1961, the total output from the basin was 240,700 long tons valued at $2.8 million. The Pea Ridge plant, presently under construction, will have an ultimate capacity of 12,000 long tons of mine-run iron ore per day. The plant is expected to become operational early in 1964, at which time the mine and mill will employ from 800 to 900 workers.

(4) Limestone. The Meramec Basin produced $11 million worth of limestone products in 1961. The dolomite found in the western and central portions of the basin is used locally for road stone and agricultural lime. High calcium limestone, prevalent in the eastern part of the basin, is suitable for concrete aggregate and cement and lime manufacture.

(5) Sand, gravel, and clay. Dredging of alluvial river deposits in the lower basin, particularly in St. Louis County, provides a major source of sand and gravel. Although sand can also be obtained from the Missouri and Mississippi Rivers, high quality gravel is only available to the St. Louis area from the Ozark streams. Because transportation costs are a large part of the final cost of gravel, it is desirable to have mining operations as close to the St. Louis area as possible. Five million tons of construction sand and gravel, valued at $6.3 million, and 487,000 tons of silica sand, valued at $1.8 million, were obtained from the Meramec Basin in 1961. Silica sand is used primarily for glass manufacture, grinding, and polishing. In 1960, Missouri ranked fifth in the nation in the value of clay mining. The Meramec Basin clay fields yielded 727,500 tons of refractory clay valued at $3.4 million in that year.

c. Manufacturing. Although there is manufacturing in many small towns throughout the basin, St. Louis represents the major center. St. Louis leads the nation in diversification of industry, and this diversification gives the area a solid base for economic stability. There are over 3,000 manufacturing establishments in the area, and no one industry employs more than 10 percent of the total manufacturing employment. The labor force in the St. Louis metropolitan area has grown approximately 12.5 percent between 1950 and 1960. During the same period, employment increased by approximately 12.1 percent. The trend toward increased unemployment in the nation is reflected in the St. Louis metropolitan area where unemployment increased

from 4 percent in 1950 to 4.4 percent in 1960. Total employment in the St. Louis metropolitan area in 1960 was approximately 764,000. The value added by manufacture for the United States and the St. Louis metropolitan area between 1947 and 1958 is indicated in TABLE 8.

TABLE 8
United States and St. Louis metropolitan area, value added by manufacture

Year	United States ($1,000)	Metropolitan St. Louis ($1,000)	Percent St. Louis is of nation
1947	$ 74,290,000	$1,296,000	1.7
1954	116,913,000	2,088,000	1.8
1956	139,613,000	2,444,000	1.8
1958	142,093,000	2,328,000	1.6

Reference - Census of Manufacture, U. S. Bureau of Census.

d. Commercial transport. Aside from achieving diversification of industry, St. Louis has become a major transportation and distribution center. It is the nation's second largest rail center and second largest trucking center. Its municipal airport is capable of handling all types of aircraft. St. Louis is one of the busiest inland ports on the Mississippi River, handling annually a million and a half tons of petroleum products, a quarter of a million tons of iron ore, 165,000 tons of scrap iron, 440,000 tons of finished steel and tin plate, and 10 million tons of coal. In addition, $200 million worth of grain moves in and out of the metropolitan area by water.

15. RECREATION

a. General. Recreation has long been an important use of the Meramec Basin. Specific attractions include more than 25 large springs, about 50 known caves, and pleasant, wooded slopes and clear streams in the upper headwaters. Most recreational developments are concentrated near the streams and are in public, semi-public, and private ownerships. Public lands are scattered throughout the basin and are administered primarily by the U. S. Forest Service, the Missouri Park Board, and the Missouri Conservation Commission. See FIGURE 7, PUBLIC RECREATION AREAS.

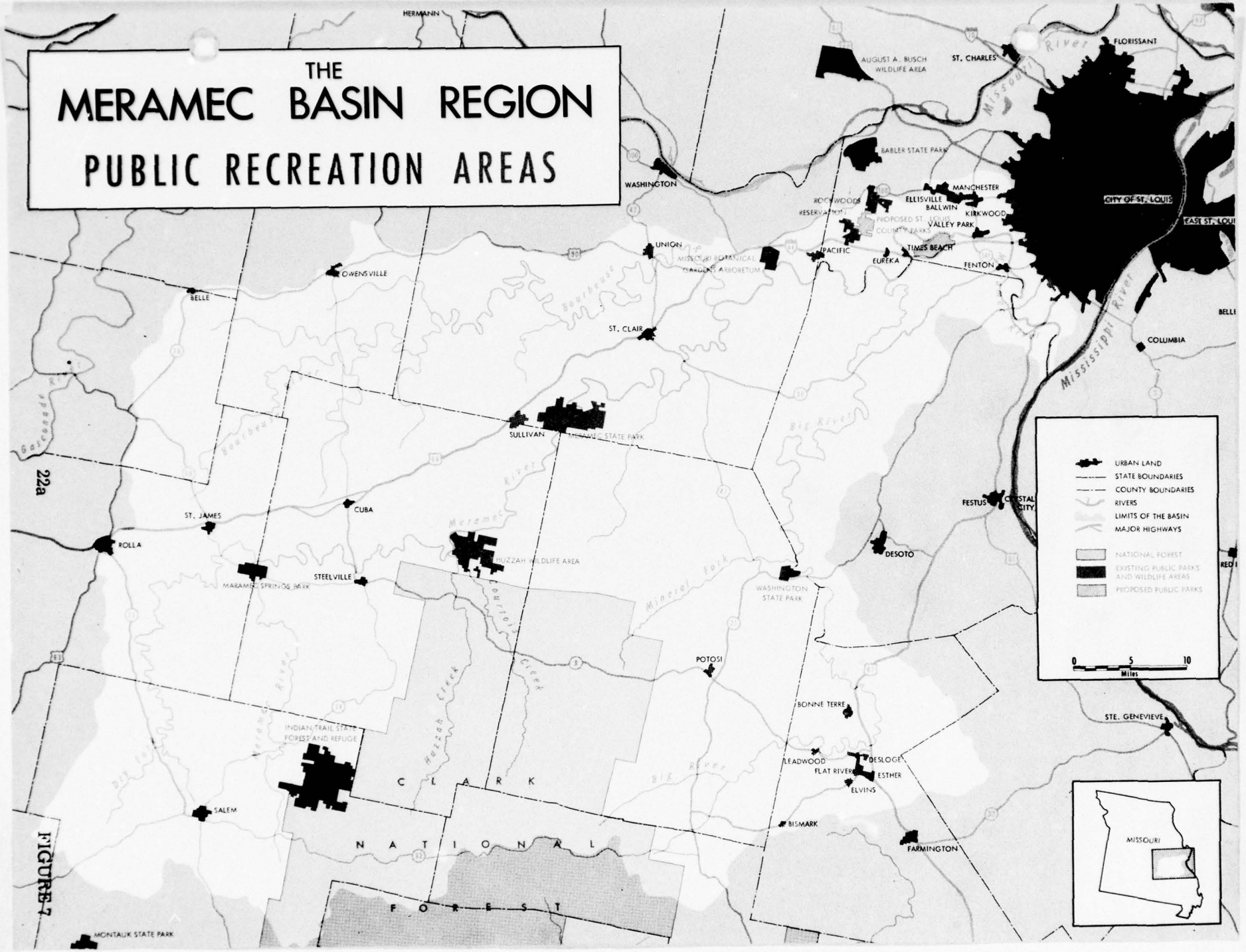

THE
MERAMEC BASIN REGION
PUBLIC RECREATION AREAS
HERMANN
AUGUST A. BUSCH WILDLIFE AREA
ST. CHARLES
FLORISSANT
Missouri River
BABLER STATE PARK
WASHINGTON
ROCKWOODS RESERVATION
MANCHESTER
ELLISVILLE
BALLWIN
KIRKWOOD
VALLEY PARK
CITY OF ST. LOUIS
EAST ST. LOUIS
PROPOSED ST. LOUIS COUNTY PARKS
UNION
MISSOURI BOTANICAL GARDEN & ARBORETUM
PACIFIC
EUREKA
TIMES BEACH
FENTON
OWENSVILLE
BELLE
ST. CLAIR
COLUMBIA
Mississippi River
Gasconade River
Bourbeuse River
SULLIVAN
MERAMEC STATE PARK
Big River
22a
ST. JAMES
CUBA
Meramec River
ROLLA
HUZZAH WILDLIFE AREA
MARAMEC SPRINGS PARK
STEELVILLE
Courtois Creek
Mineral Fork
WASHINGTON STATE PARK
DESOTO
FESTUS
CRYSTAL CITY
POTOSI
BONNE TERRE
STE. GENEVIEVE
INDIAN TRAIL STATE FOREST AND REFUGE
Huzzah Creek
LEADWOOD
FLAT RIVER
DESLOGE
ESTHER
ELVINS
C L A R K
SALEM
BISMARK
FARMINGTON
N A T I O N A L
F O R E S T
MONTAUK STATE PARK
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
NATIONAL FOREST
EXISTING PUBLIC PARKS AND WILDLIFE AREAS
PROPOSED PUBLIC PARKS
0 5 10
Miles
MISSOURI

FIGURE 7

Churches and organizations, such as the YMCA and Boy Scouts, maintain camps in various parts of the Meramec Basin. Numerous fishing and hunting clubs, sportsmen's clubs, and the like also maintain facilities. These generally involve small acreages. Private, non-commercial establishments, ranging in size from a fraction of an acre to an area of several thousand acres, provide additional recreation facilities. A few commercial resorts are in operation in the upper Meramec Basin. Several beaches operate along the major streams, and commercial swimming pools with picnic areas are common in the lower basin area. Deterioration of some of the earlier recreational facilities, coupled with changes in income, leisure, and mobility, which allow people to go greater distances in search of recreation, has reduced the present recreational use of the lower Meramec Basin. Despite this relative decline, recreation is still one of the major land uses in the lower basin. TABLE 9, showing use of the major public recreational areas, is based on latest available information. These recreational facilities are available without fee in most instances and represent the principal public recreation resources of the area. It is estimated that these facilities could support approximately 3,900,000 visitor-days annually. On this basis, the facilities are operating at about 75 percent capacity at the present time.

TABLE 9
Current recreational visitor-days

Recreation facility	Visitor-days
Clark National Forest	200,000
Rockwood Reservation	300,000
Meramec and Onondaga Caves	150,000
Area picnic sites	
Meramec, Onondaga, and Fisher Caves	300,000
Maramec Spring	215,000
St. Louis County parks	1,000,000
Meramec State Park	593,000
Washington State Park	155,000
Huzzah State Forest	11,000
Indian Trail State Forest and Refuge	3,000
Total	2,927,000

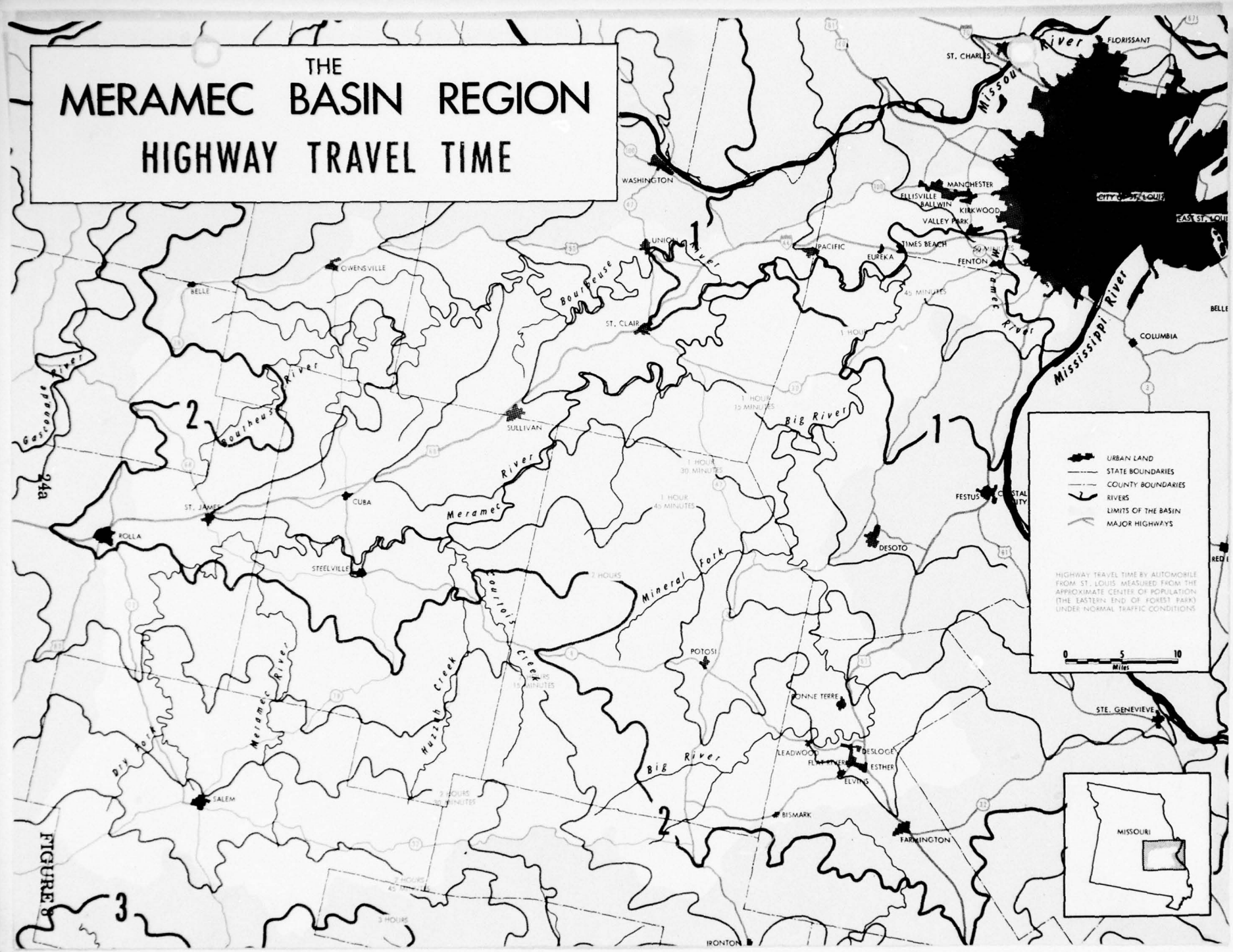

THE
MERAMEC BASIN REGION
HIGHWAY TRAVEL TIME
WASHINGTON
UNION
PACIFIC
EUREKA
TIMES BEACH
FENTON
MANCHESTER
ELLISVILLE
BALLWIN
KIRKWOOD
VALLEY PARK
FLORISSANT
ST. CHARLES
Missouri River
Meramec River
Mississippi River
COLUMBIA
OWENSVILLE
BELLE
ST. CLAIR
Bourbeuse River
SULLIVAN
Gasconade River
Gourneus River
Meramec River
Big River
CUBA
ST. JAMES
ROLLA
STEELVILLE
FESTUS
DESOTO
Mineral Fork
Courtois Creek
Huzzah Creek
Dry Fork
Meramec River
POTOSI
BONNE TERRE
LEADWOOD
DESLOGE
ESTHER
ELVINS
FLAT RIVER
BISMARK
FARMINGTON
IRONTON
STE. GENEVIEVE
SALEM
1 HOUR
1 HOUR 15 MINUTES
1 HOUR 30 MINUTES
1 HOUR 45 MINUTES
2 HOURS
2 HOURS 30 MINUTES
2 HOURS 45 MINUTES
3 HOURS
45 MINUTES
1
2
3
24a
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
HIGHWAY TRAVEL TIME BY AUTOMOBILE FROM ST. LOUIS MEASURED FROM THE APPROXIMATE CENTER OF POPULATION (THE EASTERN END OF FOREST PARK) UNDER NORMAL TRAFFIC CONDITIONS
0 5 10
Miles
MISSOURI

FIGURE 8

under construction and is scheduled to be in operation in 1966. The initial installation will include a 525,000-kilowatt turbogenerator. The plant will have an ultimate capacity of approximately 1 million kilowatts. Outlays for new plants and equipment in the next 5 years will be 17 percent higher than the $283,700,000 spent by Union Electric in the past 5 years. The Mid-Continent Area Power Planners organization, of which Union Electric is a member, was formed early in 1963 to take further steps to achieve the fullest benefits possible from areawide cooperation. This organization, comprised of 22 local power suppliers with an installed capacity of about 7.5 million kilowatts at the end of 1962, operates in 10 northcentral states, and currently serves a population of more than 3 million with a peak demand of about 6.5 million kilowatts. Other power companies which supply electrical energy to the area are listed below. None of the power companies serving the area have generating plants in the basin.

Black River Electric Cooperative, Fredericktown, Missouri
Crawford Electric Cooperative, Bourbon, Missouri
Sho-Me Power Corporation, Marchfield, Missouri
Gasconade Electric Cooperative, Dixon, Missouri
Arkansas-Missouri Power Company, Potosi, Missouri (Division office)
Missouri Power and Light Company, Jefferson City, Missouri
Intercounty Electric Cooperative, Licking, Missouri
Citizens Electric Corporation, Ste. Genevieve, Missouri

b. Municipal facilities. The municipalities of Sullivan, Owensville, Salem, and Rolla operate their own power plants. Further data on the area's power facilities will be found in APPENDIX F prepared by the Federal Power Commission.

18. WATER RESOURCES AND USAGE

The water resources of the Meramec River Basin are primarily used for municipal, industrial, and mining purposes. The present water usage averages 70 gallons per capita per day (g.p.c.d.) in the upper basin and 110 g.p.c.d. in the lower basin. From information furnished by the Missouri Geological Survey and Water Resources Department at Rolla, Missouri, the water usage in the Meramec River Basin percentagewise by humans, livestock, and industry is 83, 5, and 12 percent, respectively. Groundwater is the primary source of supply for municipalities in the Bourbeuse River Basin. In the Big River Basin, the municipal supplies are

obtained from wells and mines. Because of the poor quality, at least one community has changed from mine water to well water. The municipalities in the lower basin obtain water from the alluvial deposits and the Missouri and Meramec Rivers. Metropolitan St. Louis uses water from the Mississippi, Missouri, and Meramec Rivers. Approximately 6.5 m.g.d. are obtained from the Meramec River.

19. FLOOD DAMAGES

a. Areas subject to flooding. Approximately 129,400 acres of land in the Meramec Basin are subject to flooding, of which 10,500 acres are also subject to flooding by Mississippi River backwater. Flooded areas are distributed throughout the basin as shown in TABLE 10.

TABLE 10
Acres subject to flooding

Location	Miles of stream	Total acres in flood plain
Meramec River (below Big River)	37.5	17,100*
Meramec River (Big River to Bourbeuse River)	27.3	11,600
Meramec River (above Bourbeuse River)	126.8	26,900
Big River	132.2	23,300
Bourbeuse River	127.3	22,300
Meramec River tributaries	132.7	18,000
Big River tributaries	46.7	4,600
Bourbeuse River tributaries	55.4	5,600
Total	685.9	129,400

*Includes 10,500 acres subject to Mississippi River backwater flooding.

b. Extent of flooding. There are approximately 79,300 crop and pasture acres in the flood plain subject to flooding. The average annual number of acres flooded approximate 56,700, of which 34,800 acres are in crop and pasture. The towns of Valley Park and Pacific on the Meramec River, with a 1960 population of 3,452 and 2,795, respectively, are the major urban areas in the basin which have

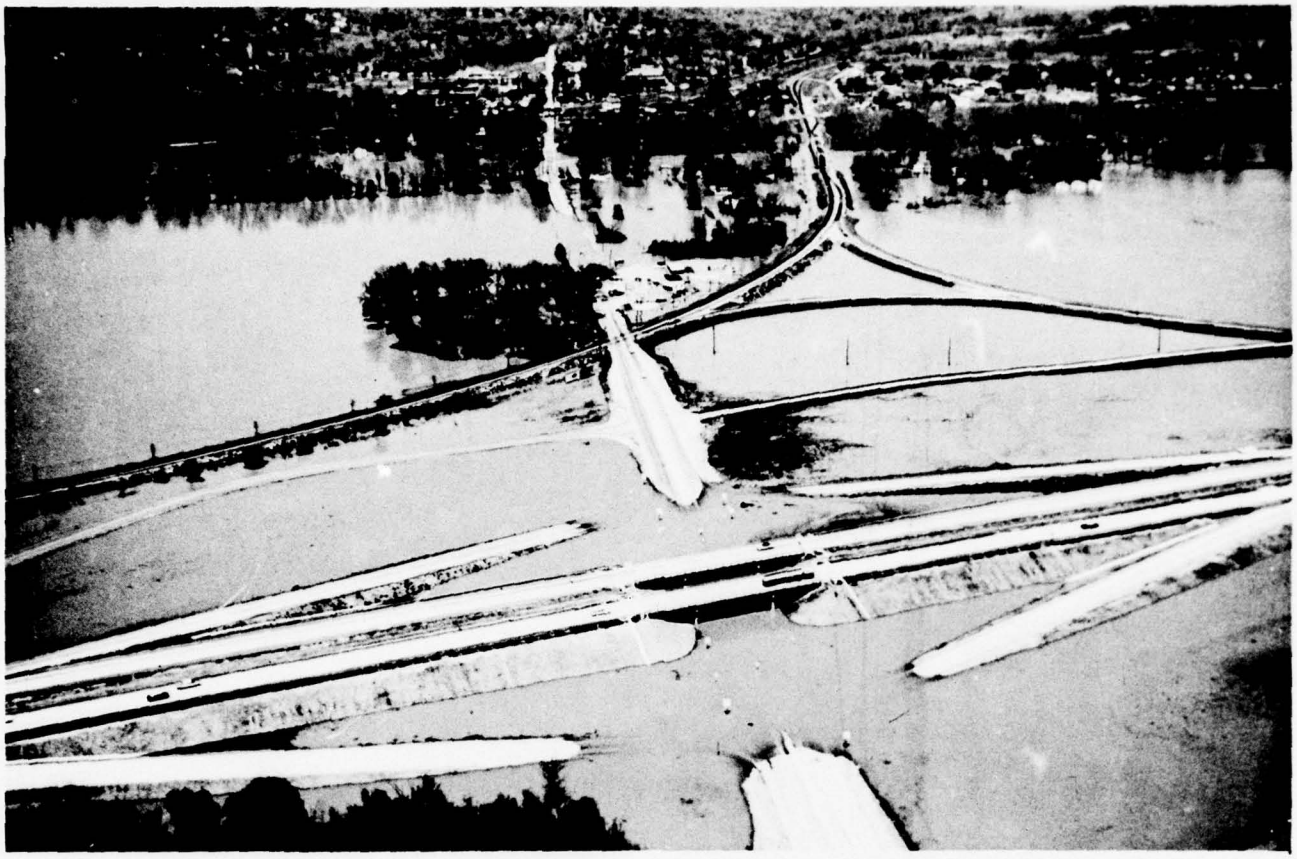
experienced flooding. In addition, the smaller communities of Fenton, Times Beach, Glencoe, and Cedar Hill are minor damage centers. Major recreation facilities, such as Meramec Caverns, Onondaga Cave, and Meramec State Park on the Meramec River and Washington State Park on the Big River, as well as certain resort facilities, are also subject to periodic flooding. There are approximately 2,100 clubhouse developments along all the watercourses throughout the basin that are damaged by the less frequent floods. Most of these are concentrated primarily along the Meramec River in St. Louis and Jefferson Counties and the lower reaches of the Big River in Jefferson County.

c. Types of flood damages. Interviews were conducted with farmers and property owners to ascertain the extent of damage from past floods. All damages are considered to be tangible in nature and consist of damages to crops, farm sets, residential, commercial, and industrial establishments, clubhouses, roads, railroads, bridges, and miscellaneous rural property. The total estimated average annual damages to these developments under existing conditions are shown in TABLE 11. See FIGURE 9, FLOOD PHOTOS.

TABLE 11
Average annual flood damages (present conditions)

Type of damage	Meramec River - main stem: Below Big River	Meramec River - main stem: Big River to Bourbeuse River	Meramec River - main stem: Above Bourbeuse River	Meramec River tributaries	Total, Meramec River and tributaries *	Big River	Big River tributaries	Total, Big River and tributaries	Bourbeuse River	Bourbeuse River and tributaries	Total, Bourbeuse River and tributaries	Total, flood plain
Agriculture	$ 91,300	$ 86,200	$188,600	$170,600	$ 536,700	$229,800	$52,700	$282,500	$151,900	$55,400	$207,300	$1,026,500
Urban	317,000	8,600	65,000	38,600	429,200	1,000	0	1,000	500	0	500	430,700
Rural farm sets	3,100	1,200	7,400	24,700	36,400	19,500	3,100	22,600	4,500	7,500	12,000	71,000
Clubhouses	27,800	3,000	5,600	1,300	37,700	16,200	800	17,000	4,400	0	4,400	59,100
Roads	26,400	4,400	13,000	7,300	51,100	18,800	2,700	21,500	5,000	3,300	8,300	80,900
Railroads	39,300	5,500	1,900	0	46,700	1,700	0	1,700	3,300	0	3,300	51,700
Bridges	600	300	900	3,600	5,400	5,000	1,200	6,200	1,000	2,900	3,900	15,500
Fences	13,500	11,500	27,800	22,900	75,700	26,600	6,100	32,700	21,300	9,600	30,900	139,300
Equipment and livestock	1,800	1,400	2,700	0	5,900	3,700	800	4,500	600	0	600	11,000
Erosion	1,800	1,400	2,700	3,600	9,500	2,900	700	3,600	2,400	1,300	3,700	16,800
Total	$522,600	$123,500	$315,600	$272,600	$1,234,300	$325,200	$68,100	$393,300	$194,900	$80,000	$274,900	$1,902,500
Say	$523,000	$123,000	$316,000	$273,000	$1,235,000	$325,000	$68,000	$393,000	$195,000	$80,000	$275,000	$1,903,000

* Exclusive of Big and Bourbeuse Basins.



Flooding along the main stem of the lower Meramec in May, 1961. Parts of Valley Park (on the opposite side of the river, in background) and parts of state highway 141 are inundated. However, the major transportation arteries, Interstate 44 (foreground) and the Frisco Railroad, remain open. (UPI Photo by Walter A. Frerek)

Interruption of traffic on secondary roads by high water.

FIGURE 9

SECTION IV - EXISTING PROJECTS AND IMPROVEMENTS

20. CORPS OF ENGINEERS

There are no existing Corps of Engineers improvements in the Meramec River Basin. Authorization for construction of a dam on the Meramec and one on the Big River was included in the Flood Control Act of 28 June 1938. Definite project studies initiated in 1943 were expanded to include consideration of alternate sites. A definite project report, prepared in 1949, recommended that reservoirs at Meramec Park on the Meramec River, Union on the Bourbeuse River, and Cedar Hill on the Big River be substituted for the originally authorized projects for flood control. Due to lack of public acceptance at that time, the projects were deferred for restudy.

21. OTHER FEDERAL AGENCIES

The U. S. Department of Agriculture, Forest Service, owns and manages approximately 192,000 acres of the Clark National Forest lying within the boundaries of the Meramec River Basin. In addition to timber management and development, that agency has initiated establishment of picnic areas and camping facilities for public use throughout the land under its management. Soil conservation districts have been established in 5 of the 15 counties located in the Meramec Basin. These are St. Louis, Franklin, Reynolds, Dent, and Texas Counties. There are no reservoirs constructed or currently authorized for construction in the basin under Public Law 566. However, funds were provided in Fiscal Year 1963 under the authority of Section 6 of Public Law 566 to the Soil Conservation Service, the Economic Research Service, and the Forest Service to initiate a comprehensive basin survey. This survey is scheduled for completion late in Fiscal Year 1965. The Department of Agriculture is coordinating its study with and will take into consideration proposals by the Corps of Engineers.

22. NON-FEDERAL IMPROVEMENTS

The principal non-Federal improvements in the area are the Meramec State Park near Sullivan, Missouri, containing 7,153 acres, and Washington State Park on the Big River near DeSoto, Missouri, containing 1,101 acres. Each of these parks provide fishing, boating, overnight cabin accommodations, dining lodge, water, and sanitary facilities. A park at Maramec Spring has been developed at the site

of a historic iron ore smelter and is maintained by the James Foundation. It is open to the public without charge. Stocked trout fishing is maintained by the Missouri Conservation Commission in the Spring Branch with a $1.00 daily charge to fishermen. Indian Trail State Forest and Refuge contains approximately 13,250 acres, and is located near Salem, Missouri. This area is maintained primarily for timber management and development and as a wildlife refuge. Public-use facilities are limited at the present time.

SECTION V - IMPROVEMENTS DESIRED

23. PUBLIC HEARINGS

a. Extent. A public hearing, attended by 1,400 people, was held in St. Clair, Missouri, on 7 April 1961 in order to insure that full consideration would be given to the public viewpoint in planning for the optimum development of the water resources of the basin. Expressions of public opinion were continually solicited as the study developed. In September 1962, approximately 5,000 copies of an Information Bulletin were published and distributed to interested people in the basin. This bulletin outlined the purpose of the present study and presented criteria and alternative solutions under consideration. Subsequently, 25 informational meetings were held at the invitation of local interests in all parts of the basin and the St. Louis area to discuss the progress of the study and obtain opinions. In addition to these meetings held by the District Engineer or members of his staff, the Meramec Basin Corporation held informational meetings in eight of the basin communities for the same purpose; viz, soliciting public opinion as to the best plan of development for the basin. The Meramec Basin Corporation, through its Cooperative Planning Committee, has also provided means of obtaining the participation of local interests in the planning procedures of the State and Federal agencies which were collaborating in the study.

b. Summary of views. The vast majority of comments received have pointed out the need for development of the water resources in the Meramec River Basin in the interests of flood control, pollution abatement, and recreation. Residents of the lower basin described heavy damages which they had suffered from flooding. The need for control of headwater streams and furtherance of soil conservation were also stressed. It has been pointed out that the construction of reservoirs and resulting recreational opportunities would be a major factor in improving the economy of the basin which presently suffers from unemployment and underemployment, and a major portion of which is designated as redevelopment areas eligible for assistance under the Area Redevelopment Act. Others voiced concern with preservation of historic sites and scenic beauty of the region and with maintaining the clear-flowing streams. Further expressions were made by individuals recommending against inclusion of water storage to be drawn down for improvement of navigation on the Mississippi River, citing the detrimental effects on recreational activities and on fish and wildlife. A great many letters were received from residents of the town of Morse

Mill on the Big River recommending against further consideration of any dams below that town which would result in disruption to that community.

24. MERAMEC BASIN RESEARCH PROJECT

Studies presented by the Research Project indicated that the greatest benefits accruing to the development of the water resources of the Meramec Basin would result from recreation attendance. It further determined that recreation attendance would be directly measurable by the distance from St. Louis. In accordance with these assumptions, six reservoirs were investigated and recommended for consideration in any study that was made in the basin. These proposed damsites were: Pacific, located at mile 37; St. Clair, mile 69.9; Virginia Mines, mile 82.4; and Meramec Park, mile 107.5, all on the Meramec River, and Byrnes Mill, mile 0.5, and Cedar Hill, mile 22.6, on the Big River. It was pointed out that some of these reservoir sites were alternatives to others in the list, and that, should any of these larger reservoirs be built, smaller reservoirs also should be considered to satisfy the recreation needs of upstream areas. Areas recommended for the smaller reservoirs were in the lead belt area and tributaries of the upper Big, upper Meramec, and upper Bourbeuse Rivers, and Dry Fork Creek. Conventional hydroelectric power possibilities were pointed out at the Pacific site; however, these were small. Although not investigated, it was suggested that especially favorable circumstances may exist at certain reservoir sites for peaking power by use of pumped storage. The Research Project's report further recommended:

a. An early start on one large reservoir plus a smaller one.

b. Reservoir shoreline control by the developing agency, together with adoption of rural zoning laws by county governments to prohibit haphazard, unsightly, and undesirable developments around the periphery.

c. Efforts be made to preserve portions of some streams, such as Huzzah and Courtois Creeks and the upper Meramec River, for floating and other stream uses, and to guarantee their status against future development.

d. That flood plains subject to frequent inundation should be zoned to prevent use which would result in damage when floods occur. Uses compatible with the flood hazard were stated to be parks and grazing land.

e. Full-scale concentrated rehabilitation of forests, both for recreation and as a contribution to soil and water stabilization.

f. Establishment of local watershed improvement districts under the Soil Conservation Service.

25. OTHER LOCAL GROUPS

As previously indicated, the Meramec Basin Corporation has provided a good measure of assistance in obtaining the views of the general public. In addition, numerous informational meetings have been held with other local groups, such as the Missouri Conservation Federation, the Anglers Club, Chambers of Commerce, community service clubs, and other groups throughout the basin and in the St. Louis area. It is the consensus of these groups that an over-all plan of reservoir development for the basin would be greatly beneficial because its present economy is inhibited as a result of inadequate water resource development. It was also apparent to these groups that such a basinwide plan was beyond the capabilities of local interests and that they must look to the Federal Government for the needed planning and financial assistance.

26. LOCAL COOPERATION OFFERED

Consistent with legal authority under Missouri law, all appropriate State agencies have indicated their willingness to participate in the development and maintenance of facilities and services required for optimum public use of the reservoir areas. The Meramec Basin Corporation has stated that one of its major goals is to assist the State government in establishing adequate water policies. Through its Cooperative Planning Committee, it has established subcommittees with the objective of achieving desirable planning and zoning ordinances and the development, maintenance, and operation of selected recreational facilities and services by communities in close proximity to certain reservoirs.

27. NATURE AND EXTENT OF LOCAL OPPOSITION

As with all public works projects, there are a number of individual landowners who would be displaced by the reservoirs and are opposed to such programs. There have also been expressions received from those who oppose public works programs in general

in the interest of Government economy. A group known as the Meramec Rivers Association advocates a dam at mile 37.0 Meramec River (Lake Pacific) or at mile 0.5 on the Big River (Byrnes Mill). This group desires to concentrate all reservoir recreational activities at one large reservoir and leave the remainder of the free-flowing streams of the basin in their present status.

SECTION VI - PROJECTED ECONOMIC GROWTH AND RELATED WATER RESOURCE PROBLEMS

28. SOURCES OF INFORMATION

Sources of information on projected economic growth include APPENDICES I, J, and L, prepared by the Forest Service, Department of Agriculture; Bureau of Mines, Department of the Interior; and Public Health Service, Department of Health, Education, and Welfare, respectively. Data also were utilized from APPENDIX A, prepared by the Meramec Basin Research Project; the U. S. Department of Agriculture publication "Land and Water Resources, A Policy Guide"; and miscellaneous Department of Commerce statistical publications.

29. PROJECTED ECONOMIC GROWTH

a. General. The St. Louis metropolitan area in the downstream portion of the Meramec River Basin and the mining area in the southeastern portion have contributed significantly to the wealth of the nation in the past and should continue to do so in the future. Much of the economy in the remainder of the basin presently verges on semi-depressed. However, the basin, with its attractive wooded wilderness areas, has a high recreation potential, which can be enhanced by the provision of lakes for water-based recreational developments. Increased development in the basin will occur from expansion of the St. Louis metropolitan area; from new mineral discoveries and more efficient production of iron, lead, and other ores; from increased demands for products of agriculture; and from rehabilitated and improved forest management, with new and expanded markets for wood materials. Anticipated urban and industrial expansion will place an increased demand on power supply. Discussion of the factors which will influence economic growth in the basin is presented in the following subparagraphs.

b. Population. The population of the basin will show a significant growth in the future, particularly in the lower portion of the basin within the St. Louis metropolitan area. TABLE 12 shows the comparative growths of the nation, the Meramec River Basin, and the St. Louis metropolitan area. TABLE 13 shows the division of basin population between rural and urban. See also FIGURE 10, POPULATION PROJECTIONS. The estimates for the United States to year 2020 are the median projections developed by the Economic Task Group of the Interagency Water Resources Council staff. The growth from 2020 to 2070 was extrapolated using a 1.5 percent annual growth rate based on the low

projections between 1960 and 2020 as developed by the Economic Task Group. Data shown in the table for the Meramec Basin were developed by the Public Health Service, as outlined in APPENDIX L. The average annual growth rate of the St. Louis metropolitan area was approximately 0.1 percent higher than that of the nation between 1910 and 1960. Data shown in the following tables assume that the metropolitan area population will continue to grow at a rate 0.1 percent higher than that of the nation to year 2020 and thence increase at the national rate to year 2070.

TABLE 12
Population projections of Meramec River Basin and St. Louis metropolitan area compared to the United States

	Population (thousands)			Average annual percent growth per period			Percent of U. S. total	
Year	United States	Meramec River Basin	St. Louis met. area	United States	Meramec River Basin	St. Louis met. area	Meramec River Basin	St. Louis met. area
1960	180,700	212	2,060	--	--	--	0.12	1.14
1980	254,100	375	2,990	1.79	2.89	1.89	0.15	1.18
2000	358,300	640	4,290	1.73	2.72	1.83	0.18	1.20
2020	502,000	1,000	6,100	1.68	2.25	1.78	0.20	1.22
2070	1,054,700	3,000	13,490	1.50	2.21	1.50	0.28	1.28

TABLE 13
Urban and rural projected population of the Meramec River Basin

	Population (thousands)		
Year	Urban	Rural	Total
1960	71	141	212
1980	195	180	375
2000	520	120	640
2020	912	88	1,000
2070	2,920	80	3,000

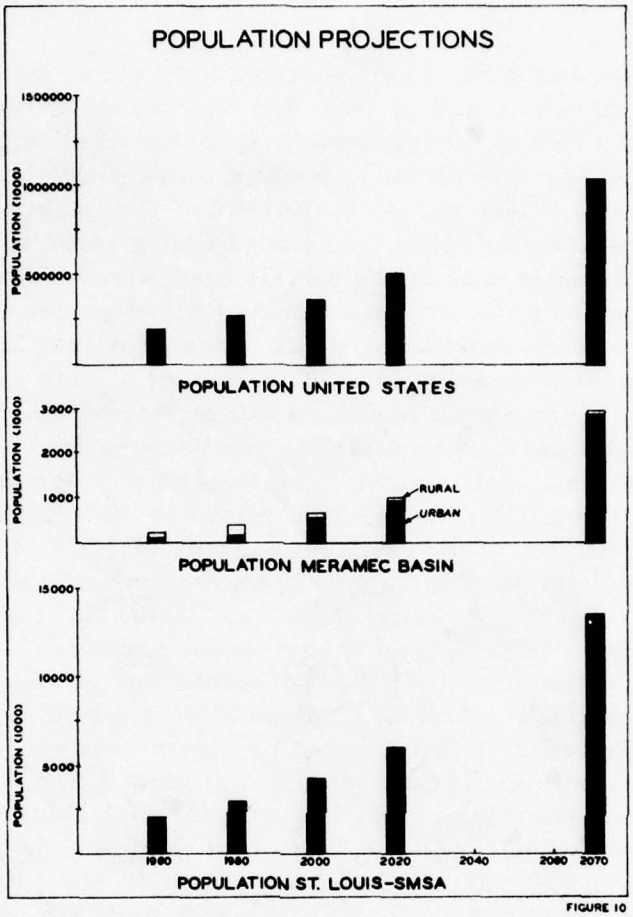


FIGURE 10

c. Potential land use. Except for the lower reaches of the basin in the vicinity of the St. Louis metropolitan area, no significant change in land use is anticipated. Most of the land which can be placed in agricultural use is cropped at the present time. The topography and the soil types in the remaining areas are not conducive to conversion to cropland. While no significant change in cropland is expected, there are signs that some of the poorer croplands will be converted to pasture. Additional land requirements for expanded urban and industrial development in the upper portion of the Meramec Basin will not be significant. However, in the lower basin area, urbanization is presently expanding and will continue to expand in the future. In 1940, the population of St. Louis County was about

19 percent of that of the St. Louis metropolitan area; by 1950 it had increased to 24 percent, and in 1960 was 34 percent of the area population of over 2,000,000 persons. An analysis of potential population to 1980 for highway planning purposes in the St. Louis metropolitan area, prepared by the U. S. Bureau of Public Roads and the Missouri Highway Commission, concluded that growth will be principally on the west side of the Mississippi River. A primary factor of this expansion in urbanization is time-distance travel. Major urban growth is now taking place along principal highways completed and under construction. The amount of land used by industry for any given output has been rapidly increasing and reflects both the horizontal production methods and parking space requirements. Indications are that many industries now in the central city area will move to outlying areas, and, with new industries coming into the area, additional lands will be required. Lack of room for expansion, site obsolescence, and transportation difficulties are the major problems currently facing industries in the St. Louis metropolitan area. It is the finding of many recent surveys that, until reorganization of the multiplicity of governmental units within the metropolitan area takes place and adequate zoning ordinances are enacted and enforced, a large number of industries will locate outside of the urban areas. Many industries finding a need for locating in the general St. Louis metropolitan area for distribution or other reasons are building in the lower portion of the Meramec Basin. An example is the $50 million Chrysler assembly plant located near Valley Park. The plant started operations in June 1959 and employs 2,600 people. Other sizable plants are now under construction in the same general area. Because of frequent flooding in the lower basin, the St. Louis County Planning Commission has prepared plans designating the bottom land areas along the Meramec River primarily for agricultural and recreational uses. Assuming protection from headwater floods on the Meramec River and from flooding by backwater from the Mississippi River, it is anticipated that there will be a demand for changed land use in the bottoms, between Pacific and the mouth of the Meramec River, for urban and industrial uses over the next 50 years.

d. Agriculture. Almost all land suitable for agricultural use is presently under production. The best of this land is located in the flood plains where crop yields are substantially higher than in the upland areas. Based upon field surveys, interviews with agricultural authorities, including university professors, extension

agents, feed and chemical researchers, and others, it was concluded that crop yields in the flood plains will increase markedly due to improvements in the genetic field, greater knowledge of the nutrient balance required for optimum yields, and improved machinery and equipment. Better uses of fertilizers, pesticides, and weed killers will also contribute to higher yields. From this information and trend indications based on county yield values, it has been estimated that by year 2070, yields will be 108 percent greater for corn than at present, 144 percent greater for wheat and soybeans, and 72 percent greater for hay. Future yields estimated for the flood plain during flood-free years and without flood control improvements are shown in TABLE 14 and FIGURE 11, PROJECTED MEDIAN CROP YIELDS. The range in yield values shows the variation to be expected in different flood plain localities.

TABLE 14

Estimated future crop yields in the flood plain during flood-free periods and without flood control improvements

	1970	2020	2070
Corn (bu/ac)	72 to 104	122 to 174	130 to 185
Wheat (bu/ac)	34 to 42	64 to 79	68 to 85
Soybeans (bu/ac)	35	64	70
Hay (tons/ac)	2.8 to 3.8	4.3 to 5.6	4.5 to 5.9

PROJECTED MEDIAN CROP YIELDS

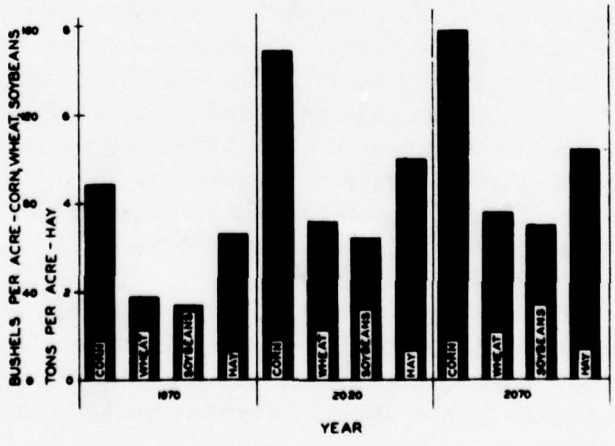


FIGURE 11

In its 1962 publication "Land and Water Resources, A Policy Guide", the U. S. Department of Agriculture estimates that farm output in dollars by 1980 will be 46 percent greater than that in 1959 with a corresponding increase in crop production amounting to 42 percent, in pasture production amounting to 41 percent, and in product added by livestock amounting to 55 percent. Using future crop yields as determined in APPENDIX Q for eight Meramec Basin counties, it is estimated that lesser increases would occur by 1980 in the Meramec Basin, amounting to 37 percent for crop production, 26 percent for pasture production, and 42 percent in products added by livestock. Trend indications are that increases by year 2070 would be 114 percent for crops, 76 percent for pasture, and 126 percent for livestock. Corresponding values of crop and livestock products sold at 1959 dollar levels would be $45,200,000 in 1959, $63,000,000 in 1980, and $98,800,000 in year 2070. Except for small truck gardens located near the mouth of the Meramec River, amounting to about 200 acres, and two alfalfa fields in the upper reaches of the river, irrigation is not practiced. The basin is located in a semi-humid climate where annual rainfall amounts are generally adequate for crop production. For this reason, little need for irrigation in the future is indicated. In the event that modifications in future cropping practices should require a more stabilized water supply to maximize yields, it is anticipated that such supply will be obtained from wells rather than from large distribution systems using river water. This is due to the fact that the basin, located in the Ozark Mountains region, has a high groundwater level suited for well supply. Furthermore, the present and anticipated woodland coverage of the basin is conducive to maintaining a high groundwater level.

e. Forestry. The U. S. Forest Service expects an increase in timber production in the basin from the present cutting of 27,000,000 board feet annually to a projected 80,000,000 board feet from the same acreage by year 2060. This increase is based principally upon the demand for high quality forest products. A 300-ton pulp mill, employing 100 persons, is expected to begin operations by 1970. Total employment in lumber and timber operations is expected to increase to about 1,200 persons by year 2070. See APPENDIX I.

f. Mining. Future demand for mineral products should continue to grow as the activities to which they contribute increase. If the renewed interest in Meramec Basin mining continues its present pace, the basin's mineral output should increase within the next 10

years from one-third to nearly one-half of Missouri's total production. The most notable indication of this resurgence in mining activity is the Pea Ridge iron mine and beneficiating plant being developed jointly by the Bethlehem Steel and St. Joseph Lead Companies in Washington County 10 miles from Sullivan, which is expected to become operational early in 1964. The plant is designed to upgrade and pelletize 12,000 long tons of ore per day. When in full operation, the company will have a total annual payroll of from $4,000,000 to $5,000,000. Comparable iron ore deposits are under extensive investigation for development at Bourbon in Crawford County and at Kratz Spring in Franklin County. It is estimated that 10,000,000 long tons of iron ore will be produced in the Meramec Basin in 2070, which will require total basin employment of approximately 3,000 workers in the mining and associated activities. Lead production is expected to increase from approximately 100,000 tons in 1960 to about 220,000 tons in 2000. The reserves are anticipated to begin to phase out and be depleted by 2020. Barite production is expected to increase from about 238,000 tons in 1961 to about 270,000 tons by 2000, at which time reserves may be depleted. Anticipated employment in lead and barite mining will be between 400 and 500 persons. Assuming continued growth in the construction industry, projected demand for limestone from the basin is 46,000,000 tons in 2070. The 1961 production was approximately 9,000,000 tons. Employment in this production will be about 1,800 persons in 2070. Demand for sand and gravel will also continue with the increase in construction. The projected demand by 2070 for silica sand and commercial sand and gravel from the basin is 34.5 million tons with total employment estimated at 2,600 persons. It is estimated that in 1975 the Meramec Basin will produce 910,000 tons of refractory clay, employing between 400 and 500 workers. The volume of clay production after 1975 has not been estimated because of lack of data on reserves. Further information on mineral resources and mining is contained in APPENDIX J.

g. Manufacturing. Substantial growth in manufacturing can be anticipated in the lower portion of the basin, most of which is located in the St. Louis metropolitan area. Manufacturing has long been a key determinant of economic growth in St. Louis. Food, transportation equipment, chemicals, and primary metal industries produce over one-half of its output. A detailed analysis of the changing industrial patterns in the St. Louis metropolitan area and the demand for and supply of industrial land to 1980 is contained in an appendix to Volume III of the Meramec Basin Research Project report, APPENDIX B. Estimates derived in the analysis therein were based

on trend indications of value added by manufacture, value added per employee, and the number of employees per acre, modified by considerations of future industrial output, technology, space requirements, site preferences, and transportation. A feature finding of the analysis is that, while the growth of manufacturing in St. Louis has not kept pace with many other cities in the past due to shifts in some production to other areas and declines in regional markets, substantial increases in value added by manufacture are indicated for most industries. Correspondingly fewer industrial employees per industry but much more industrial space per employee will be required. With the consideration that technological and market changes cannot be definitely predicted, the report presented both high and low estimates of future land requirements. These showed an increase in land requirements to 1980, ranging from a low estimate of 17 percent to a high estimate of 68 percent, averaging 42 percent. Estimates of population growth from 1960 to 1980 for the St. Louis metropolitan area show a 45 percent increase, indicating a larger proportion of the population will be employed in other than the manufacturing industries in the future. Population projections from 1960 to years 2000, 2020, and 2070 show increases of 108 percent, 196 percent, and 555 percent, respectively. While it is impracticable to relate population and manufacturing employment trends because of the unknown degrees of automation that will take place in the future, it is considered that there is a rational relationship between population and total labor force. Based thereon, substantial growths in total employment, including manufacturing, are indicated for the future. The need for space for this increase in manufacturing will require utilization of land in the lower Meramec Basin. In the middle and upper portions of the Meramec Basin, the only significant increase in manufacturing activity will be in the resource-oriented industries, principally in the mineral and forest product areas.

30. FUTURE FLOOD CONDITIONS

Except in those reaches of the middle and lower Meramec River that will be affected by expanding urbanization, present types of development subject to flood damage are expected to continue. The flood plains are used primarily for agricultural pursuits, and it is anticipated that generally they will continue in that use. There has been no significant new development of recreation facilities or week-end dwellings within the flood plain in the past two decades.

There will be problems regarding encroachment as urbanization reaches the flood plain unless adequate zoning against it is enacted. The plan now under preparation by the St. Louis County Planning Commission designates the flood plain on the north side of the river as "open space" to be used for agriculture and for recreational purposes. Jefferson County has recently established a Planning Commission which will consider zoning requirements in the flood plain on the south side of the river. Without positive flood protection, building development in the flood plain within the metropolitan area will be discouraged. For this reason, there is no indication that future annual property damages will differ from those presently experienced. Agricultural flood damages will increase monetarily because of anticipated increases in crop yields, as shown in TABLE 14. Therefore, agricultural flood damages will continue to be the major flood problem in the basin. A summary of average annual flood damages under future conditions without improvement is shown in TABLE 15.

31. WATER SUPPLY

The future water supply requirements for the Meramec River Basin are based on the projected population growth, a rising standard of living, and increased industrialization and commercial development. APPENDIX L includes a study of future needs of the area made by the Public Health Service, Department of Health, Education, and Welfare. For the purpose of this study, the basin is divided into the upper basin and the lower basin, as shown on PLATE 1. The water needs are indicated for the base period of 1970 and future periods of 2020 and 2070.

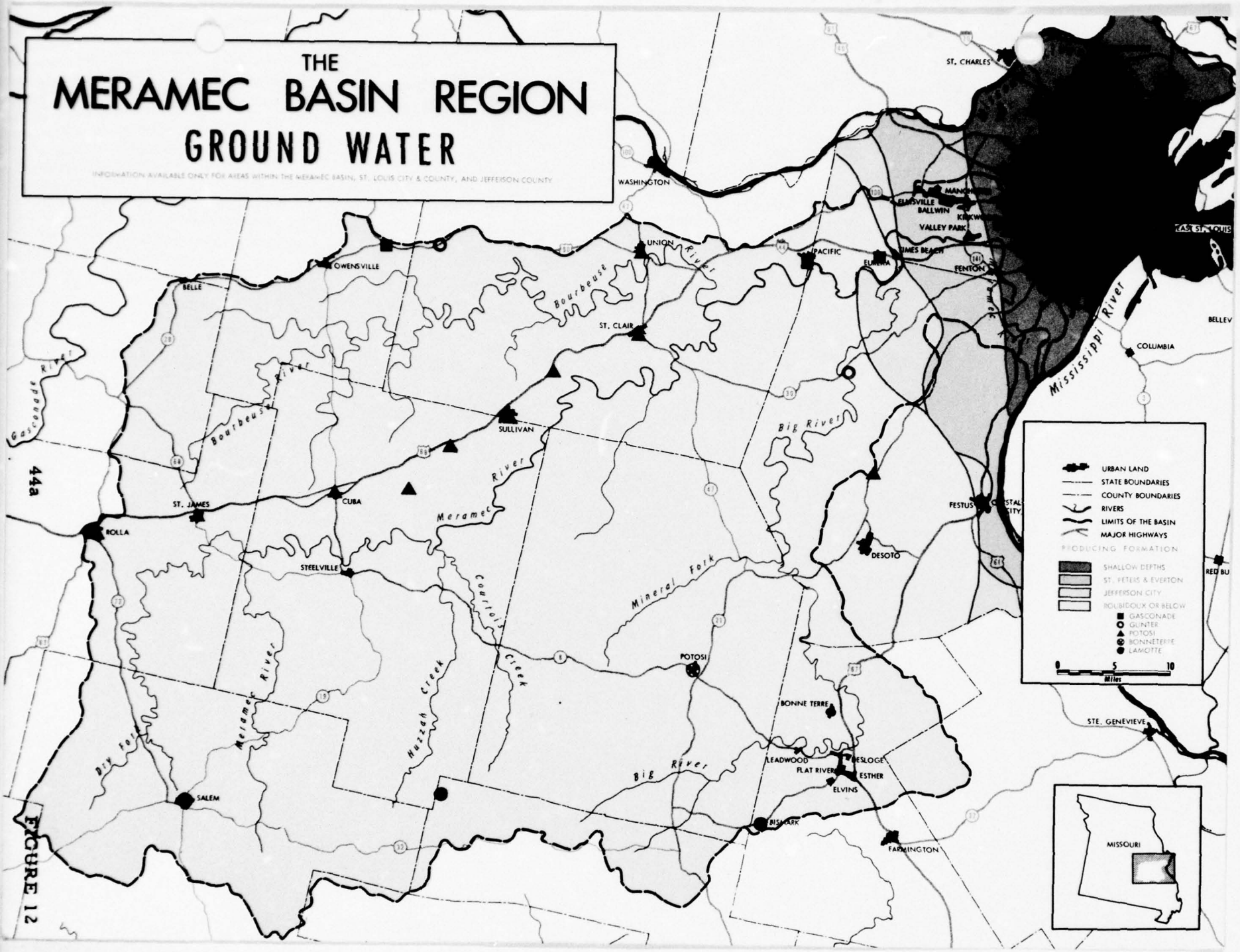
a. Upper basin. The population of the upper basin is expected to increase from about 120,000 in 1960 to about 1,000,000 in 2070. As a result of projected industrial and commercial growth, water use is expected to increase from 100 gallons per capita per day (g.p.c.d.) in 1970 to about 130 g.p.c.d. in 2020 and 160 g.p.c.d. in 2070. The U. S. Geological Survey report in APPENDIX K states that virtually all water used in the upper basin is obtained from groundwater sources, and concludes that the quantity of groundwater available is sufficient to meet the projected needs of 2070. Producing formations of groundwater sources are shown on FIGURE 12, GROUND WATER. The water quality meets the Public Health Service Drinking Water Standards; however, hardness ranges from 73 to 446 parts per million.

TABLE 15
Projected average annual flood damages without improvement

Type of damage	Meramec River - main stem: Below Big River*	Meramec River - main stem: Big River to Bourbeuse River	Meramec River - main stem: Above Bourbeuse River	Meramec River tributaries	Total, Meramec River and tributaries**	Big River	Big River tributaries	Total, Big River and tributaries	Bourbeuse River	Bourbeuse River tributaries	Total, Bourbeuse River and tributaries	Total, flood plain
Agriculture	$163,800	$154,500	$320,800	$260,500	$ 899,600	$406,300	$ 85,000	$491,300	$275,500	$103,100	$378,600	$1,769,500
Urban	317,000	8,600	65,000	38,600	429,200	1,000	0	1,000	500	0	500	430,700
Rural farm sets	3,100	1,200	7,400	24,700	36,400	19,500	3,100	22,600	4,500	7,500	12,000	71,000
Clubhouses	27,800	3,000	5,600	1,300	37,700	16,200	800	17,000	4,400	0	4,400	59,100
Roads	26,400	4,400	13,000	7,300	51,100	18,800	2,700	21,500	5,000	3,300	8,300	80,900
Railroads	39,300	5,500	1,900	0	46,700	1,700	0	1,700	3,300	0	3,300	51,700
Bridges	600	300	900	3,600	5,400	5,000	1,200	6,200	1,000	2,900	3,900	15,500
Fences	13,500	11,500	27,800	22,900	75,700	26,600	6,100	32,700	21,300	9,600	30,900	139,300
Equipment and livestock	1,800	1,400	2,700	0	5,900	3,700	800	4,500	600	0	600	11,000
Erosion	1,800	1,400	2,700	3,600	9,500	2,900	700	3,600	2,400	1,300	3,700	16,800
Total	$595,100	$191,800	$447,800	$362,500	$1,597,200	$501,700	$100,400	$602,100	$318,500	$127,700	$446,200	$2,645,500
Say	$595,000	$192,000	$448,000	$362,000	$1,597,000	$502,000	$100,000	$602,000	$318,000	$128,000	$446,000	$2,645,000

* Approximately 10,500 acres are subject to flooding by backwater from high Mississippi River stages. Damages chargeable to Mississippi River backwater amount to $29,400 to crops and $88,800 to property.

** Exclusive of Big and Bourbeuse Basins.


THE
MERAMEC BASIN REGION
GROUND WATER
INFORMATION AVAILABLE ONLY FOR AREAS WITHIN THE MERAMEC BASIN, ST. LOUIS CITY & COUNTY, AND JEFFERSON COUNTY
ST. CHARLES
WASHINGTON
UNION
PACIFIC
OWENSVILLE
BELLE
ST. CLAIR
SULLIVAN
CUBA
ST. JAMES
ROLLA
STEELVILLE
POTOSI
SALEM
BONNE TERRE
LEADWOOD
FLAT RIVER
DESLOGE
ESTHER
ELVINS
BISMARK
FARMINGTON
DESOTO
FESTUS
COLUMBIA
STE. GENEVIEVE
Bourbeuse River
Big River
Meramec River
Mineral Fork
Courtois Creek
Huzzah Creek
Meramec River
Dry Fork
Gasconade River
Mississippi River
URBAN LAND
STATE BOUNDARIES
COUNTY BOUNDARIES
RIVERS
LIMITS OF THE BASIN
MAJOR HIGHWAYS
PRODUCING FORMATION
SHALLOW DEPTHS
ST. PETERS & EVERTON
JEFFERSON CITY
ROUBIDOUX OR BELOW
GASCONADE
GUNTER
POTOSI
BONNETERRE
LAMOTTE
0 5 10
Miles
MISSOURI
44a
FIGURE 12

b. Lower basin. The lower basin is expected to have greater commercial and industrial development because of location with reference to the St. Louis metropolitan area. As a result, the amount of water used per capita will be greater in the lower area. The total present demand in the lower basin in 1960 was approximately 10,000,000 gallons per day, of which approximately 6,000,000 per day were from groundwater. The report of the Public Health Service shows the 1960 population of the lower basin as 92,000 persons with an average consumption of 110 gallons per capita per day. The groundwater supply is supplemented by 4,000,000 gallons per day drawn from the Meramec River. As shown by FIGURE 13, WATER SUPPLY NEEDS, LOWER BASIN, the water supply requirement is expected to reach 93 m.g.d. by 2020 and 400 m.g.d. by 2070. By utilizing all of the available ground and existing surface water sources in the lower basin, a demand of 50 m.g.d. can be met. This requirement is expected to be reached in about 1995, and, beyond this date, other sources will need to be developed. It is estimated that additional water supply amounting to 43 m.g.d., equivalent to approximately 65 c.f.s., will be required by the year 2020, and 350 m.g.d., equivalent to approximately 525 c.f.s., will be required by 2070. Sources of surface and alluvial groundwater are shown on FIGURE 14, ST. LOUIS AREA WATER SUPPLY.

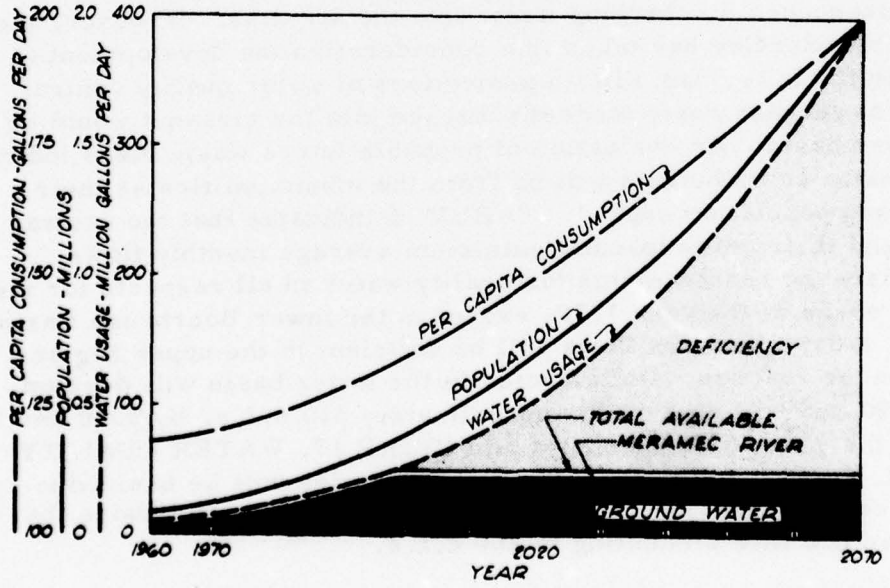


FIGURE 13

32. WATER QUALITY CONTROL

The need for water quality control in the basin was determined by considering the effects of expanding domestic, commercial, industrial, and natural pollution on the receiving streams. A detailed analysis of these requirements is presented in APPENDIX L. Stream flows during drought period, September 1953, are shown on FIGURE 15, MERAMEC BASIN, LOW STREAMFLOWS. In order for desirable stream conditions to be maintained in the basin, bacteriological requirements should be met, allowable chemical concentrations should not be exceeded, and a satisfactory dissolved oxygen content should be maintained. The extent to which maximum practicable treatment measures at the source would have to be supplemented by augmentation of low flows was determined by 50- and 100-year projections from a base year of 1970. The Public Health Service analyzed the low-flow requirements for individual stream reaches of each of the three sub-basins. The river reaches are schematically shown on FIGURE 16, RIVER SYSTEM SCHEMATIC. At the present time, the only methods of waste treatment are primary and secondary treatment plants. It is not considered economically practicable to provide a higher degree of waste treatment. There are no industries of any consequence discharging waste into the streams. However, the Public Health Service has taken into consideration the development of industry in the lower basin in its projections of water quality control needs. The largest waste loads discharged into the streams would be in the lower basin. An evaluation of probable future waste loads indicated that the major contributions will be from the municipalities as their economy and population expand. TABLE 16 indicates that the natural streams and their corresponding minimum average monthly flows would satisfy the requirements for quality water in all respects for the projected needs to the year 1970, except in the lower Bourbeuse Basin. However, 1-day minimum flows will be deficient in the upper Big and the Bourbeuse reaches. Deficiencies in the lower basin will develop before 1990 and will amount to approximately 310 c.f.s. by 2020 and 900 c.f.s. in the year 2070, as shown on FIGURE 17, WATER QUALITY CONTROL NEEDS, LOWER BASIN. Deficiencies will be basinwide by 2020. These deficiencies represent the demands over and above the 1-day mean low flow amounting to 200 c.f.s.

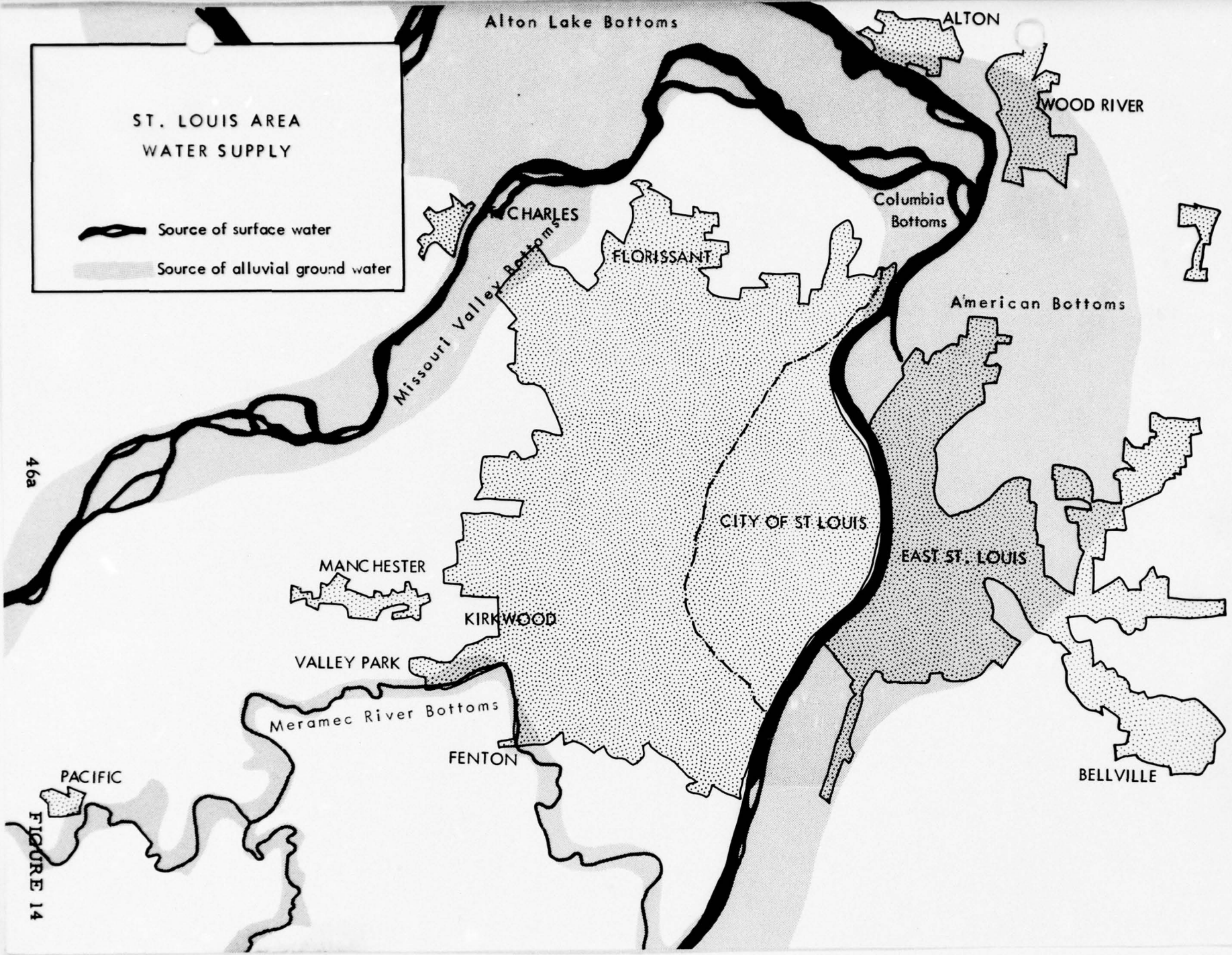


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FIGURE 14

MERAMEC BASIN, LOW STREAMFLOWS

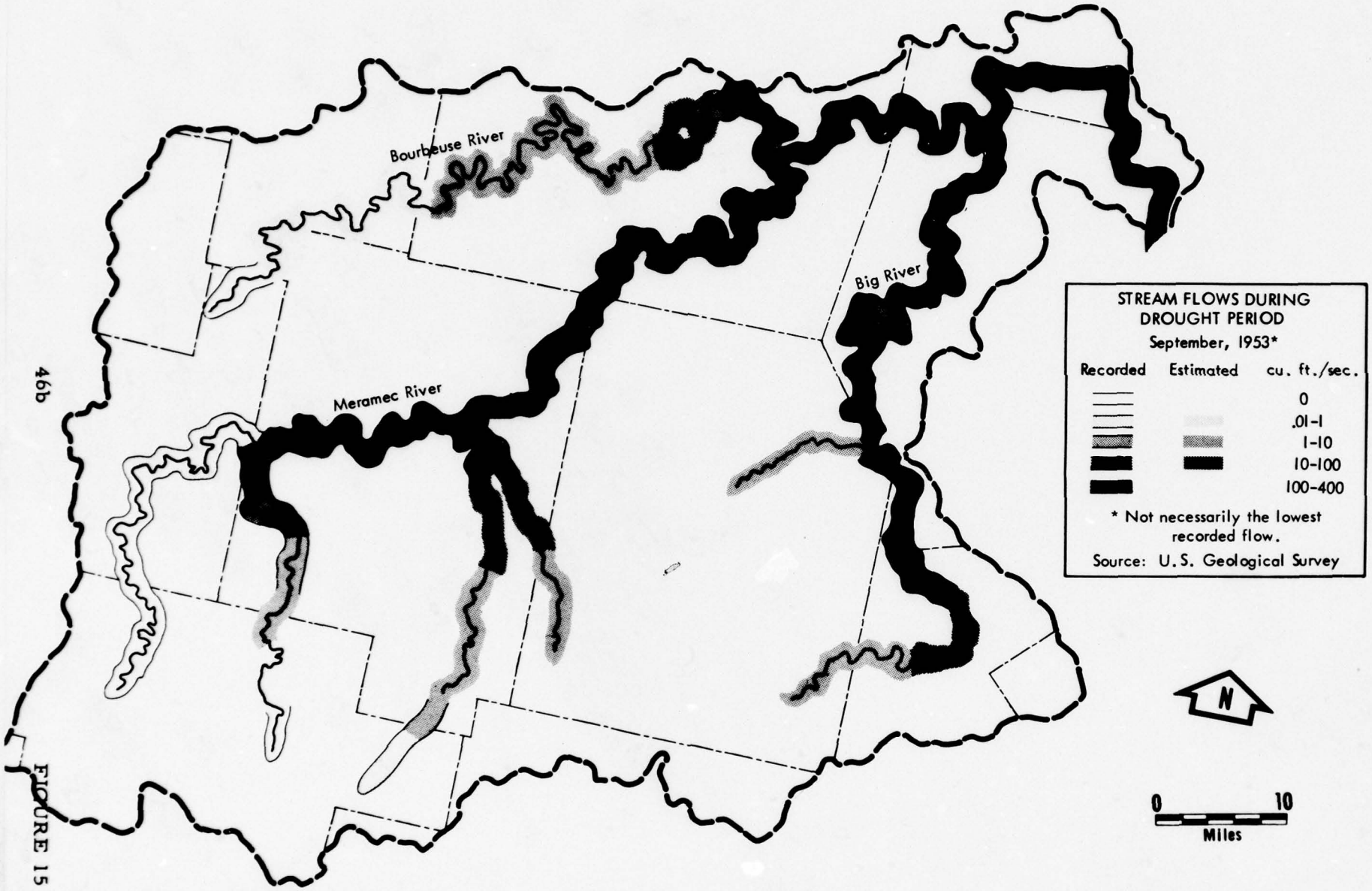

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FIGURE 15

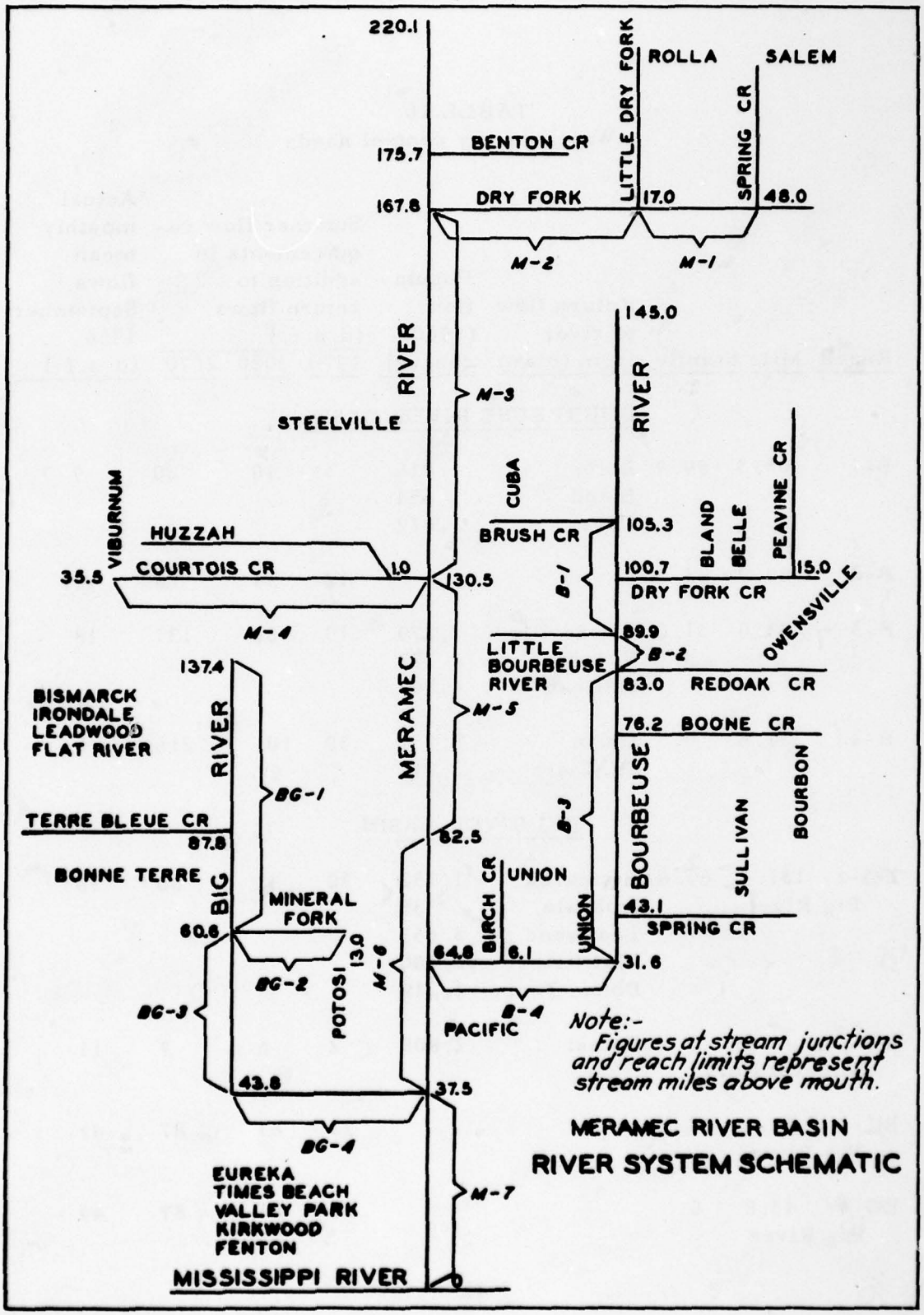

FIGURE 18
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TABLE 16
Water quality control needs

Reach	Mile to mile		Return flow to river from (town)	Population (1960 census)	Summer flow requirements in addition to return flows (d. s. f.) 1970	2020	2070	Actual monthly mean flows September 1956 (d. s. f.)
			BOURBEUSE RIVER BASIN					
B-1	105.3	89.9	Belle	1,016	3	10	20	9
			Bland	654				
			Cuba	1,672				
B-2	89.9	83.0			12	34	73	13
B-3	83.0	31.6	Owensville	2,379	19	66	131	18
			Bourbon	779				
			Sullivan	4,098				
B-4	31.6	0	Union	3,937	30	101	216	19
			St. Clair	2,711				
			BIG RIVER BASIN					
BG-1 Big River	137.4	60.6	Bismarck	1,237	30	57	80	30
			Irondale	335				
			Leadwood	3,651				
			Flat River	12,000				
			Bonne Terre	3,219				
BG-2 Mineral Fork	13.0	0	Potosi	2,805	2	6	7	11
BG-3 Big River	60.6	43.8			32	63	87	41
BG-4 Big River	43.8	0			32	63	87	49

TABLE 16 (Cont'd)

Reach	Mile	to mile	Return flow to river from (town)	Population (1960 census)	Summer flow requirements in addition to return flows (d.s.f.) 1970	2020	2070	Actual monthly mean flows September 1956 (d.s.f.)
MERAMEC RIVER SUB-BASIN								
M-1 Dry Fork	48.0	17.0	Salem	3,870	4	18	22	25
M-2 Dry Fork	17.0	0	Rolla	11,132	9	28	37	40
M-3 Meramec	167.8	130.5	Steelville	1,127	27	70	128	82
M-4 Courtois-Huzzah	35.5	0	Viburnum	590	2	4	7	47
M-5 Meramec	130.5	82.5			29	74	135	146
M-6a Meramec	82.5	64.8			29	74	135	176
LOWER MERAMEC BASIN								
M-6b Meramec	64.8	37.5	Pacific	2,795	87	340	730	195
Big River flows required for Reach 7					43	170	370	49
M-7 Meramec	37.5	0	Eureka	1,134	130	510	1,100	244*
			Times Beach	986				
			Valley Park	3,452				
			Kirkwood	29,421				
			Fenton	1,046				

* One-day mean in 1956, 200 c.f.s.

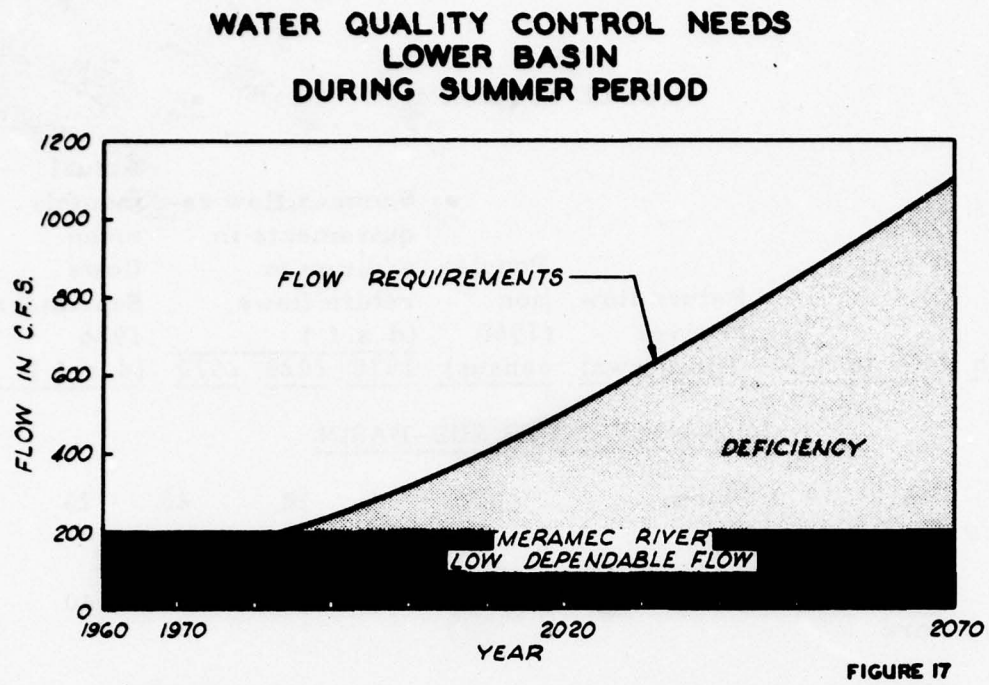


FIGURE 17

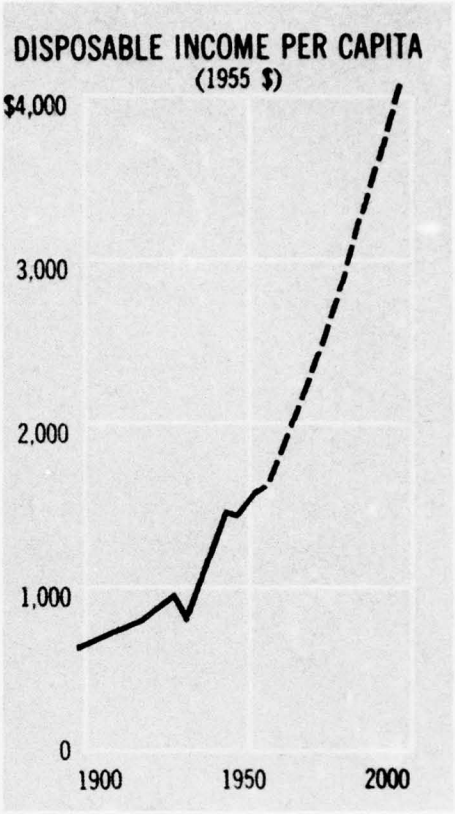
33. RECREATION

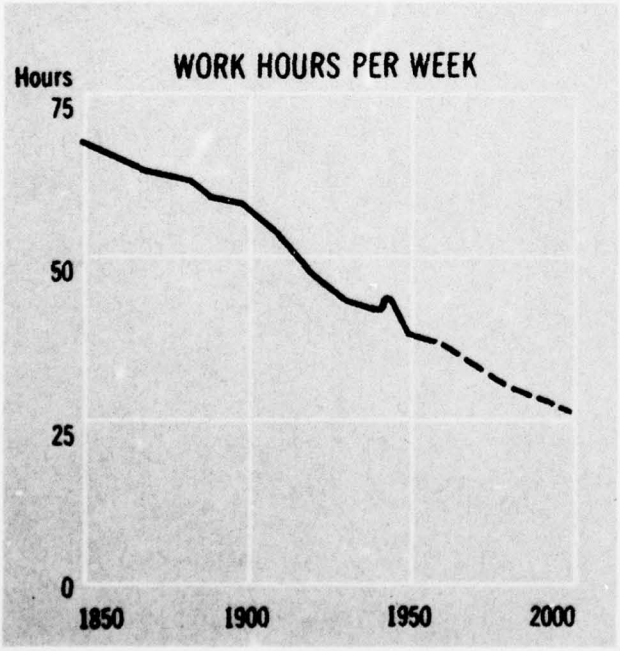
Continued technological advances are leading to more efficient needs of production, a shorter workweek, and a higher standard of living for most of the nation's population. These trends are shown on FIGURE 18, TRENDS AFFECTING OUTDOOR RECREATION. This, in turn, has created more time for leisure. As a result, there has been an increased demand for outdoor recreational activities, especially reservoir-area-associated recreation, which is strongly evidenced throughout the country by the growth of sales of boats, outboard motors, and camping and fishing equipment. It can be expected that this trend will continue. Projection of visitor-day attendance from the St. Louis area at certain reservoirs outside of the Meramec River Basin is shown on FIGURE 19, RESERVOIR ATTENDANCE. Currently, recreational facilities available in the Meramec Basin can support approximately 3,900,000 visitor-days annually. A study of the future of outdoor recreation in the greater St. Louis metropolitan region, published in Study Report 21 by the Outdoor Recreation Resources Review Commission (1962), states:

> "Perhaps even more important, or at least more pressing, than the initiation of regional planning for outdoor recreation is the provision of large water spaces for the outdoor recreation of St. Louisans. If present pressures for water facilities continue to mount at the rates we have anticipated, the failure to act and act quickly in this matter could be crucial. This is

TRENDS AFFECTING
OUTDOOR RECREATION

From: The Crisis in Outdoor Recreation by Marion Clawson





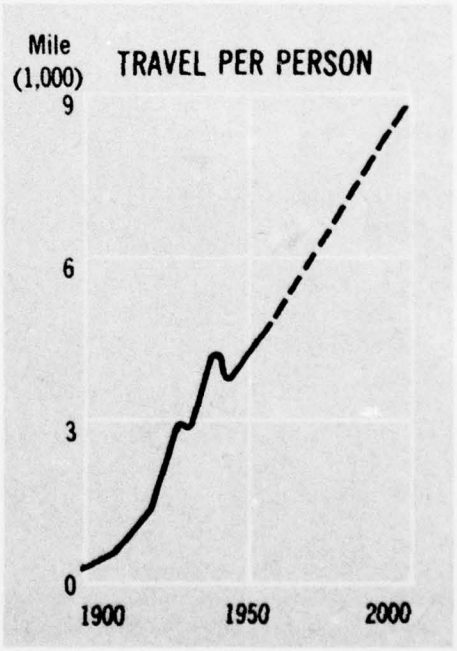


FIGURE 18

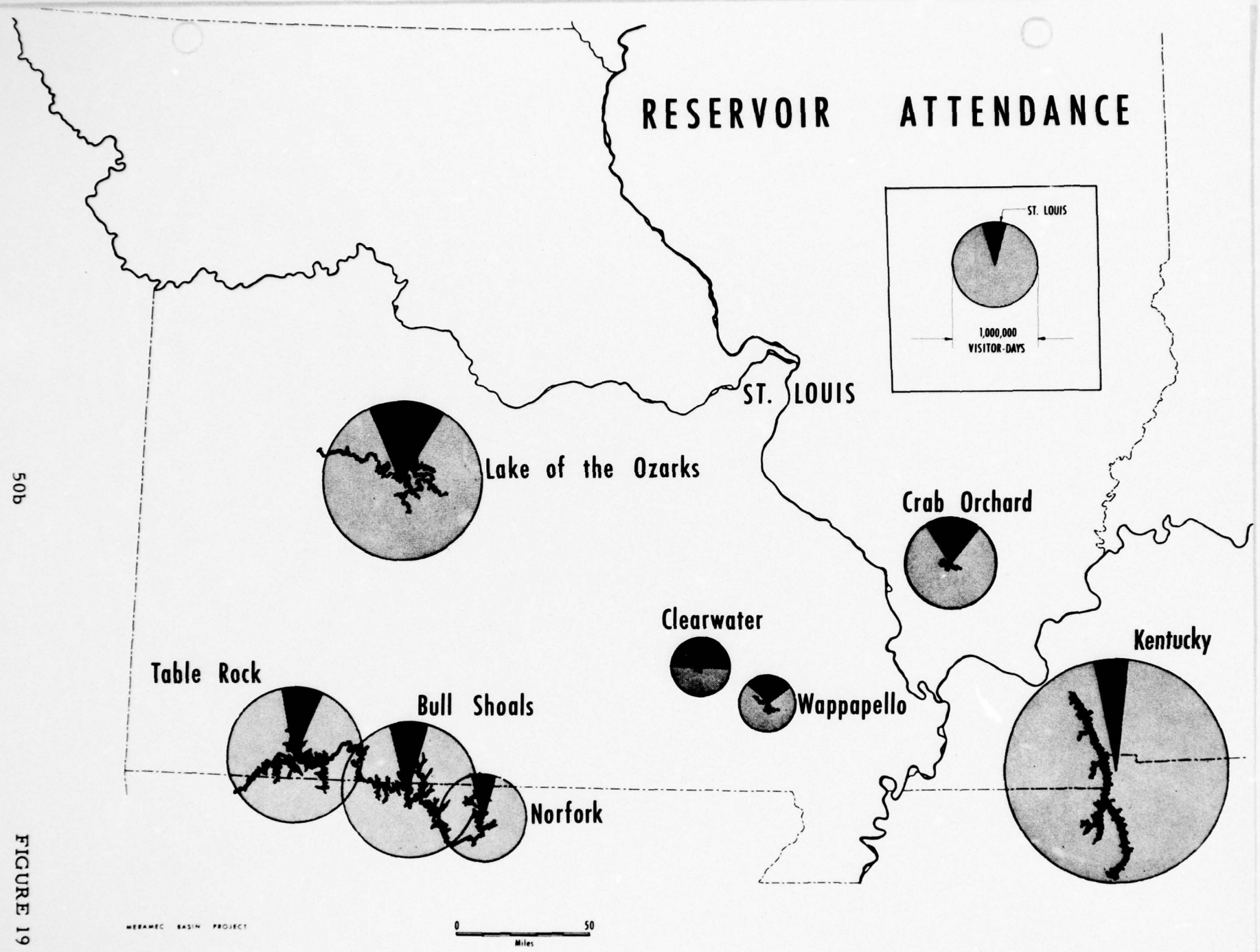


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FIGURE 19

> not merely a proposal to make life happier for St. Louis water recreationists. It may well be a matter of the life or symbolic death of the city. As amenities become more and more important in the American's choice of a place to live, work, and play, and, as American life becomes more fluid and mobile, St. Louis may well find itself defined as an undesirable area of settlement for many of the people of the land. Since cities must recruit their populations from the outside, St. Louis may find itself suffering severe economic losses without amenities to attract and maintain a growing population. Obviously, the Meramec Basin is the site that must be developed for these purposes. Failure to dam the Meramec might very well mean successfully damning the city."

Based on projected population growth and economic conditions in the zone of influence of the basin area, the Corps of Engineers estimated that by 1970 the demand for recreation will amount to 9,500,000 visitor-days annually, and that only about 40 percent of this demand will be met by existing and anticipated facilities. Further projections show that by 2020 demands will be increased by nearly one-third and that the demands met would amount to about 33 percent. Ultimately, by the year 2070 the demands would double over that of 1970, with anticipated facilities supporting less than 30 percent of this demand. To meet these future demands to the fullest extent possible, water related facilities associated with reservoir development are urgently needed.

34. FISH AND WILDLIFE CONSERVATION

The U. S. Fish and Wildlife Service, in its letter report dated 11 June 1963, furnished estimates of usage of the Meramec Basin as of 1970 under current conditions. Estimates of present and projected needs generated by population growth within the zone of influence of the basin were made by the Corps of Engineers. In 1970, the population base of the zone of influence will increase to 4,040,000, which it is estimated will generate a total need for 597,000 fisherman-days. A much larger need would be generated were it not for the general lack of access to the streams under current conditions. For the most part, the only access available to

the general public is over limited public domain lands and at public road crossings. In addition, there are a number of resort activities that charge for the privileges of stream bank or pond fishing, boat launching, or for float fishing services. With the exceptions noted above, a fisherman even wading a small stream is subject to trespass whenever he steps out of the water onto the shore. Presently, there are no large bodies of water in the basin open to the public. Under these conditions, the Fish and Wildlife Service reports that by 1970, 239,000 fisherman-days, representing 40 percent of the total need, would be met. The Fish and Wildlife Service in the same report indicates that, due to lack of hunting opportunity in the basin under current conditions, with most of the lands being posted against hunting, the basin will support only 6,570 hunterman-days in 1970. The Corps of Engineers estimates that the population in the zone of influence of the basin in 1970 will generate a need for hunting in the basin representing 16,425 hunterman-days. The basin, without further development, can meet only 40 percent of these needs. Based on population growth, it has been estimated by the Corps of Engineers that, under existing conditions, approximately 35 percent of the demand could be met by the year 2020 and less than 30 percent by the year 2070. To meet these increased demands for both hunting and fishing, development of public water areas, open streams and lakes, and improved wildlife habitat will be needed.

35. POWER

A study of projected power needs in Power Supply Area 15, which includes the Meramec River Basin, was made by the Federal Power Commission. This study forecasted peak power demands of 3,700 megawatts and 6,800 megawatts for the peak demand months of August 1970 and August 1980, respectively. Load duration curves for PSA 15, prepared by the Federal Power Commission, show a need for 490 megawatts and 675 megawatts at 10 percent load factor in 1970 and 1980, respectively. Union Electric, which markets power in PSA 15 and other areas, is undertaking an expansion program to increase its generating capacity by 1,000 megawatts by the year 1967. In addition, the Mid-Continent Area Power Planners, which furnishes power to 10 north-central states, including the Meramec Basin in Missouri, has projected its peak demands to 23,000 megawatts by the year 1980. This is more than three times its present demand. Through other Federal projects outside the immediate basin area, private utility expansion, construction of extra high voltage transmission lines, more efficient generating units, greater

interconnection among power suppliers, and exchange of low-cost power, the need for additional peaking capacity for some time into the future appears to be adequately provided for. The base load power requirements for the Meramec Basin in the foreseeable future will be supplied for the most part by thermal plants due to the abundance of low-cost bituminous coal in nearby Southern Illinois. It is the opinion of the Federal Power Commission and the Southwestern Power Administration that in the distant future low-load factor peaking capacity will become feasible, and at that time any hydropower which might be developed in the Meramec Basin could be integrated into the power grid system for the regional area.

36. NAVIGATION

Deficiencies in navigable depths in the Mississippi River are experienced during extreme dry periods and the winter season. Dependable increases in low flow from storage in tributary reservoirs during these periods would reduce the amount of dredging presently required to maintain project depth, reduce revenue losses due to light loading of barges, and reduce the cost of maintenance of dike and revetment work. In the Mississippi River and Tributary Reservoir Benefit Study made in 1961, such benefits were credited to Meramec Basin reservoirs on the basis of projects previously studied. Currently, the value of these benefits is too small to justify specific allocations of storage in reservoirs. There is no interest presently in improving the Meramec River for navigation. While it is anticipated that industries will continue to develop in the lower basin area, there are no indications at this time that these industries will be concerned with improvement of the lower reaches of the Meramec River for navigation in the foreseeable future.

37. ECONOMIC REORIENTATION

The economy of the Meramec Basin outside of the metropolitan St. Louis area is oriented toward agriculture, forestry, and mining. The decline of employment in these fields over the past years has resulted in persistent unemployment and underemployment, which currently prevail in seven counties which lie wholly or in part within the basin. Unemployment in the basin in 1960 was slightly over 6 percent as compared to 4.1 percent for Missouri and 5.6 percent for the nation. Per capita income levels in 1960 ranged from 55 percent to 83 percent for the State as a whole. The higher level reflects the influence of the St. Louis metropolitan area on economic activity in

the basin. Lowest incomes are in the upper reaches of the basin, where a large share of the total population is in the younger and older age groups. This reflects migration of younger adults who prefer to relocate in areas of greater economic opportunity. Employment in the mining industry has dropped 30 percent between 1954 and 1960, principally due to improved technology and mechanization which have been necessary for the mining industry to maintain its competitive position in a declining market. While increased developments in the basin, based on new mineral discoveries, increased demands for agriculture, and improved forest management with expanded markets, are anticipated in the future, such developments will only partially offset the depressed economy in certain areas of the basin. The Area Redevelopment Administration, in providing technical assistance and exploring the potentials for improving the economy in the area, pointed out that one of the principal sources of new employment is that associated with recreation and tourist development through the construction of reservoirs.

SECTION VII - PLAN FORMULATION

38. OBJECTIVE

The fundamental objective of the Meramec River Basin study is to devise a sound program for the development of water and related land resources to meet the immediate and long-term needs of the basin in an orderly, efficient, and timely manner.

39. FRAMEWORK PLAN

In furtherance of this objective, inter-agency agreement was reached as to a framework plan, comprised of watershed treatment of agricultural lands and forest improvement in the upper basin, multiple-purpose storage reservoirs on the main streams and tributaries, and levees or flood plain regulation in the lower basin. The general means of meeting this objective and the general areas of responsibility of the several agencies, based on probable development of all economic resources as projected in SECTION VI of the report, are defined in the following subparagraphs:

a. Agriculture. Retention of substantially all present agricultural land, amounting to about 890,000 acres in agricultural use with productivity increased by improved farming practices and flood control. Improved agronomy, control of soil erosion, and detention of runoff for control of floods in smaller streams are primarily the concern of the Soil Conservation Service. Detailed plans are presently being developed and will be contained in a separate report prepared by the Department of Agriculture. The effects of the Department of Agriculture plan on water problems of larger tributaries and main streams cannot be evaluated at this time. However, both flood-flow and low-flow problems probably will be improved, though not eliminated, and sediment loads carried into the main streams will be reduced.

b. Forestry. Retention of substantially all present forest land, amounting to approximately 1.5 million acres, under improved management. This is a primary concern of the U. S. Forest Service. Development and improvement of forest game habitat and facilities for recreation, hunting, and fishing in essentially wild streams are important associated objectives. Detailed plans are being developed in a separate report by the Department of Agriculture. The effects of the Department of Agriculture plan on water problems of all streams have not been evaluated, but probably will be small and generally beneficial to flood and low flows and water quality problems.

c. Stream regulation. Provision of an adequate supply of water for anticipated urban and industrial growth in the lower valley and for dilution to maintain water quality control after all practical treatment of pollution sources. Determination of needs and standards is a primary concern of the U. S. Public Health Service. Development of water supply is a primary concern of the Corps of Engineers. Needs over and above available groundwater and low stream flow are estimated at 375 c.f.s. by the year 2020 and 1,425 c.f.s. by the year 2070. Reservoir storage to increase low flows and pumping from the Mississippi or Missouri River are the two most likely solutions to be evaluated.

d. Flood control. Prevention of flood damage to agricultural and potential urban and industrial developments on about 100,000 acres on the main streams and major tributaries beyond the capability of the Soil Conservation Service headwater detention works. Control of flood plain occupancy by local governments is to be encouraged. The most likely solutions to be evaluated are reservoir storage, levees, and channel enlargements, all of which are a primary concern of the Corps of Engineers.

e. Recreation. Preservation and improvement for public use of outdoor recreation now afforded by streams and forested areas and development of water areas to meet a growing demand for water-based recreation near the St. Louis metropolitan area. This objective includes maximum practical preservation of game habitat and stream fishery, provision of additional lake areas, and improved lake fishery. These are a joint concern of the U. S. Fish and Wildlife Service, Bureau of Outdoor Recreation, and Corps of Engineers in planning reservoir developments.

f. Power. Production of hydroelectric power where practicable to provide peaking capacity to supplement the predominant steam-generated capacity of systems now serving the Meramec Basin and adjoining areas. Determination of need for and marketability of hydropower is the primary concern of the Federal Power Commission and Southwestern Power Administration. A large potential need for hydro-peak capacity exists. Planning for inclusion of power production in multiple-purpose reservoirs is a primary concern of the Corps of Engineers.

40. BASIN WATER CONTROL PLAN

The water control objective of the Corps of Engineers primarily concerns reservoir storage on the main streams and tributaries below

areas that may be given substantial flood protection by Soil Conservation Service headwater detention plans. The objective covers development of adequate storage in reservoirs to:

a. Meet future water supply and water quality control needs.

b. Eliminate or reduce overflow in the flood plains.

c. Provide large permanent pool areas suitable for recreational development.

Development of power is to be considered where suitable head and flow conditions prevail. Reservoirs need to be supplemented, where necessary, by levees or other means of flood control, particularly in the Mississippi River backwater area. All practical measures are to be incorporated to reduce damage to and improve fish and wildlife habitat.

41. POTENTIAL RESERVOIR SITES

a. General. To satisfy the present and foreseeable future needs for water resource development in the basin, all potential damsites, both on the main streams and tributary streams, were investigated. Previous studies, which considered numerous reservoir sites, were reviewed and supplemented by map and field reconnaissance to select possible sites that would meet the following criteria:

(1) Reservoirs should permit complete development; good sites should not be wasted with partial development.

(2) Impoundments should present no major relocation problem or unreasonable disruption to towns and communities.

(3) Sites must have a suitable foundation, and embankment materials must be available within reasonable haul distance.

(4) Main stream reservoirs should have sufficient capacity to contain the standard project flood in excess of bankfull capacity, plus a joint-use pool equal to approximately one-half this amount, and tributary stream reservoirs should have sufficient capacity to contain the 50-year flood in excess of bankfull, plus a joint-use pool of approximately one-third this amount.

(5) Site locations should be well distributed throughout the basin.

(6) Natural scenic beauty and sites of historic interest should be preserved wherever possible.

(7) Minor tributary reservoirs should not conflict with main stream impoundments retained for further study.

b. Sites considered. Thirty-six main stream sites, as shown on PLATE 2, were selected for investigation. Some of the sites overlap and are alternatives to others. A reconnaissance report was prepared on each site, describing access, foundation, embankment materials, and relocation problems in the reservoir area. Curves of area and capacity versus elevation were developed for each site. The total acre-feet of storage obtainable divided by the cross-sectional area in square feet at the damsite provided a ratio as a reasonable guide to relative construction cost per acre-foot of capacity. All of the 253 tributary and headwater sites, as shown on PLATE 3, which were previously studied by the State of Missouri as part of the 1949 report on the Meramec River, were reviewed. This review included office study and field reconnaissance of the sites. Other tributary stream sites were investigated.

c. Selection of most suitable sites. On the basis of preliminary cost studies, 20 of the 36 main stream sites were eliminated. Of the remaining 16 sites, nine were dropped from further consideration for one or more of the following reasons:

(1) Excessive cost of major relocations.

(2) Flooding of towns and communities.

(3) Loss of scenic or historic sites.

(4) More favorable alternatives are available.

(5) Substantial local opposition.

Most of the tributary reservoir sites were eliminated because of conflict with purposes to be served by the seven main stream reservoirs. Others were eliminated because of developments which had taken place since the sites were originally studied. Twenty-four sites are retained

for further study and economic analysis. Twelve of these tributary stream sites have a total capacity of less than 25,000 acre-feet, of which less than 5,000 acre-feet are for flood control and are classified as headwater reservoirs. Pertinent data for the 36 main stream sites and the 24 tributary stream sites are contained in TABLE 17.

42. STORAGE REQUIREMENTS AND CAPABILITIES

a. General. Total maximum available storage at the 31 reservoir sites selected for further study is estimated at 2,892,000 acre-feet. Each of the sites was examined to determine its capability in meeting the needs for each of several purposes. This included the determination of the amount of storage required to regulate stream flow in the interest of flood control, water supply, water quality control, and hydroelectric power, as well as provide pools for recreation and fish and wildlife conservation. Where available storage exceeded the capacities required to meet water needs as defined above, consideration was given to developing the site to its fullest potential. Maximum storage capacity was retained where this could be accomplished at a significant savings over subsequent enlargement. This insures flexibility in development of plans for future operation and provides for extension of services as they become necessary and justified. The need for storage at each site is defined in the following subparagraphs for each of the several purposes.

b. Flood control. On the main stream, storage requirements were based on retention of standard project flood in excess of bankfull capacity of the channel. Storage capacity on tributary streams was based on containment of the 50-year flood above bankfull capacity, but, where limited benefits did not warrant such storage, containment of lesser frequency floods down to a 10-year frequency was investigated. To meet the needs for flood control, combined storage amounting to 1,322,000 acre-feet is required at the 31 reservoir sites. In development of final storage requirements at each of the sites, consideration was given to the effect of retention of flood storage in upstream reservoirs. Storage requirements for flood control at each of the reservoir sites are shown in TABLE 18. At several sites, no flood control storage is provided since there is no flood problem immediately downstream and adequate storage is available at other sites for more remote downstream flood problems. Use of all practicable capacity is planned at all sites where flood control storage has not been included, as well as at those sites where only partial storage is used for flood control.

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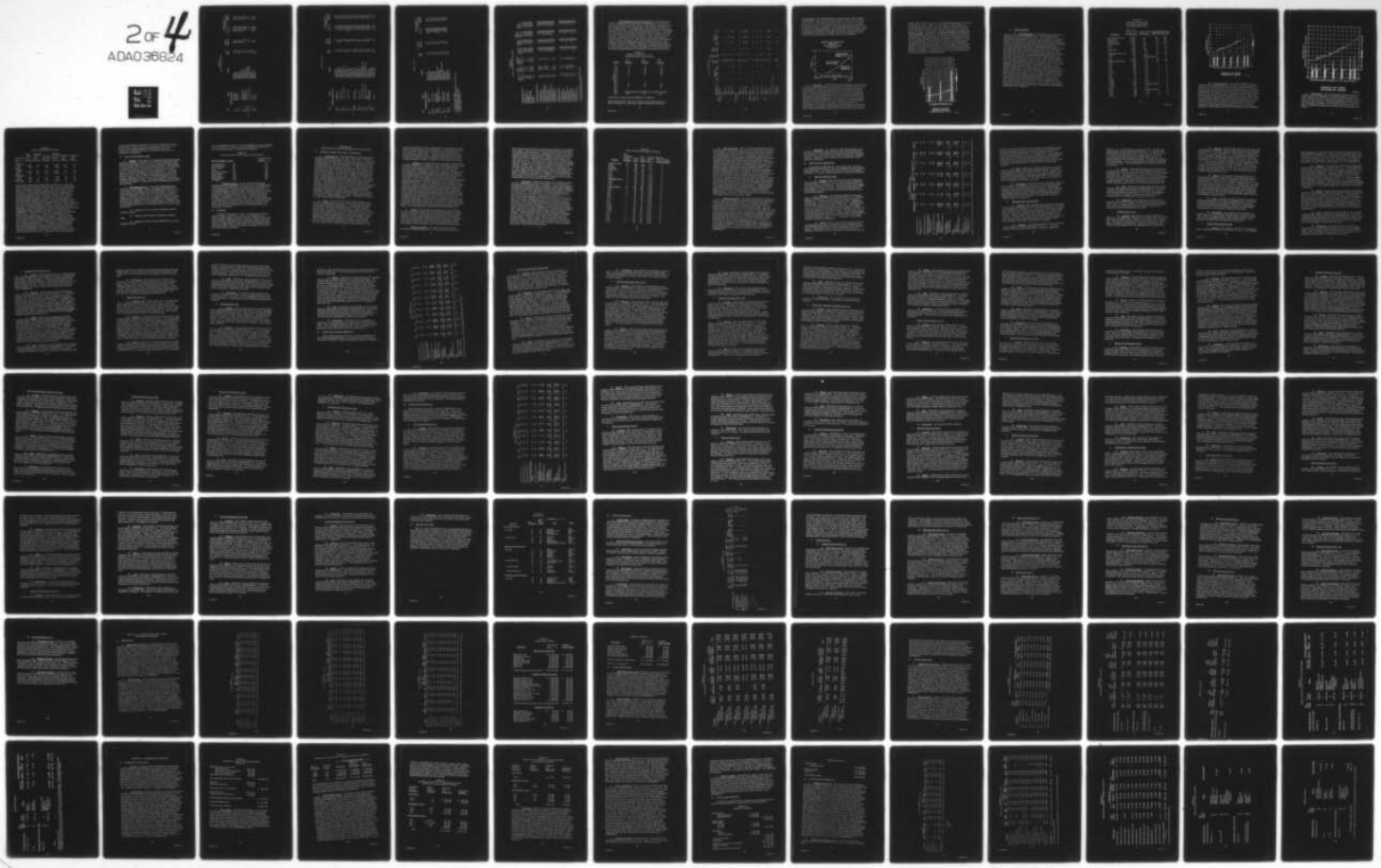


TABLE 17
Reservoir sites considered

Site		Name	Stream	River mile	Drainage area (sq. mi.)	Maximum available storage (ac.-ft.)	Maximum available storage (inches of runoff)
		Big River Sub-basin					
1		Byrnes Mill	Big River	0.5	968	660,800	12.80
2		Cedar Hill	Big River	22.6	858	601,500	13.15
H-3	*	Dry Creek	Dry Creek	7.0	9.2	2,750	5.60
2A	*	Pine Ford	Big River	43.3	788	351,300	8.36
3			Big River	59.5	732	531,600	13.62
4			Mineral Fork	1.1	187	171,100	17.16
5	*	Washington Park	Mineral Fork	5.0	160	147,200	17.25
H-9	*	Bates Creek	Bates Creek	2.7	8.0	2,240	5.24
H-4	*	Cabanne Course	Cabanne Course	0.3	8.2	2,080	4.76
H-40	*	Coonville Creek	Coonville Creek	0.1	3.9	900	4.33
7A	(1)		Terre Bleue Creek	0.4	-	-	-
I-30	*	Terre Bleue Creek	Terre Bleue Creek	11.6	19.8	7,100	6.72
8	(1)		Flat River	0.8	-	-	-
9	*	Irondale	Big River	116.5	175	161,000	17.25
10A			Cedar Creek	1.9	76	75,400	18.60
H-25	*	Big River	Big River	134.5	13.3	2,660	3.75

TABLE 17 (Cont'd)

Site	Name	Stream	River mile	Drainage area (sq. mi.)	Maximum available storage (ac.-ft.)	Maximum available storage (inches of runoff)
	Meramec River Sub-basin					
11A		Calvey Creek	3.1	37	38,600	19.56
H-5A *	Brady Creek	Brady Creek	0.2	3.1	950	5.76
13	St. Clair	Meramec River	69.9	1,803	670,000	6.97
14		Little Meramec	1.3	35	36,400	19.50
40 *	Virginia Mines	Meramec River	82.4	1,748	230,000	17.97
15A		Indian Creek	1.1	155	144,400	17.47
H-8 *	Little Indian Creek	Little Indian Creek	4.8	17.8	5,960	6.28
16		Indian Creek	9.0	96	137,000	17.60
16A		Indian Creek	11.1	126	119,100	17.72
17 *	Meramec Park	Meramec River	107.5	1,508	1,000,000	12.43
18		Brazil Creek	3.9	43	44,500	19.41
19		Huzzah Creek	1.0	479	387,600	15.17
20		Courtois Creek	6.3	187	171,100	17.16
H-10A*	Lost Creek	Lost Creek	8.0	4.2	1,240	5.54
I-15A*	Courtois Creek	Courtois Creek	18.8	122	38,000	5.84
22		Courtois Creek	19.7	73	72,700	18.67
21A		Huzzah Creek	7.0	186	170,200	17.16
I-14 *	Huzzah Creek	Huzzah Creek	24.7	112	35,400	5.93
23		Huzzah Creek	32.0	86	84,800	18.49
I-26 *	West Fork Huzzah Creek	West Fork Huzzah Creek	0.5	27	26,000	18.05
24		Dry Fork Creek	1.0	370	307,000	15.56
I-23 *	Little Dry Fork Creek	Little Dry Fork Creek	2.3	36	12,700	6.61
25	Rolla	Dry Fork	20.4	255	223,700	16.45
I-28 *	Spring Creek	Spring Creek	2.0	44	26,000	11.08
I-41 *	Benton Creek	Benton Creek	0.9	28.8	10,300	6.70
26 (1)		Crooked Creek	0.7	-	-	-
26A		Crooked Creek	4.6	50	51,000	19.13
27 *	Salem	Meramec River	191.6	175	161,200	17.27

TABLE 17 (Cont'd)

Site	Name	Stream	River mile	Drainage area (sq. mi.)	Maximum available storage (ac.-ft.)	Maximum available storage (inches of runoff)
	Bourbeuse River Sub-basin					
H-6 *	Birch Creek	Birch Creek	2.0	10.4	2,760	4.97
29 *	Union	Bourbeuse River	31.6	754	528,000	13.13
30		Spring Creek	0.8	51	52,000	19.12
H-11A*	Winsell Creek	Winsell Creek	1.0	10.6	3,050	5.40
31		Boone Creek	7.0	50	51,000	19.13
H-13A*	Boone Creek	Boone Creek	9.0	21.1	5,580	4.96
I-32 *	Redoak Creek	Redoak Creek	1.3	60	26,000	8.12
I-33A*	Little Bourbeuse River	Little Bourbeuse River	5.1	52	26,000	9.38
34 (2)	Rosebud	Bourbeuse River	95.6	421	330,000	14.70
36		Dry Fork Creek	1.6	113	107,700	17.87
H-31 *	Dry Fork Creek	*Tributary of Dry Fork Creek*	1.2	6.2	1,760	5.32
I-21 *	Peavine Creek	Peavine Creek	15.0	23.5	8,600	6.86
35		Brush Creek	1.6	72	71,400	18.59
I-35A*	Brush Creek	Brush Creek	2.5	69	26,000	7.06
I-38 *	Bourbeuse River	Bourbeuse River	127.3	121	39,000	6.04
37 (1)		Lanes Fork	1.0	-	-	-

* Retained for further study.
(1) No studies made. Deferred for geologic or other reasons.
(2) Studied as alternate to 29, Union.
"I" denotes tributary stream sites.
"H" denotes headwater sites.

TABLE 18
Pertinent data
Reservoirs considered for further study

Main stream reservoirs	Drainage area (sq. mi.)	Flood control storage (ac.-ft.)	Frequency of protection provided (yrs.)	Joint-use storage (ac.-ft.)	Sediment storage (ac.-ft.)	Net storage joint-use pool (ac.-ft.)	Total storage (ac.-ft.)
#2A Pine Ford	453*	196,700	100	88,300	12,000	76,300	285,000
#5 Washington Park	160	---	---	147,200	5,600	141,600	147,200
#9 Irondale	175	23,900	10	137,100	5,800	131,300	161,000
#40 Virginia Mines	240**	---	---	110,300	9,000	101,300	110,300
#17 Meramec Park	1,508	581,600	Std Proj	418,400	18,200	400,200	1,000,000
#27 Salem	175	30,000	20	131,200	6,000	125,200	161,200
#29 Union	754	355,600	Std Proj	172,400	11,900	160,500	528,000
Tributary stream reservoirs							
I-14 Huzzah Creek	112	27,500	50	7,900	4,000	3,900	35,400
I-15A Courtois Creek	122	29,600	50	8,400	4,800	3,600	38,000
I-21 Peavine Creek	23.5	6,300	50	2,300	1,600	700	8,600
I-23 Little Dry Fork Creek	36	---	---	12,700	2,100	10,600	12,700
I-26 West Fork Huzzah Creek	27	4,600	20	21,400	1,800	19,600	26,000
I-28 Spring Creek	44	11,800	50	14,200	2,500	11,700	26,000
I-30 Terre Bleue Creek	19.8	2,700	10	4,400	1,500	2,900	7,100
I-32 Redoak Creek	60	---	---	26,000	3,000	23,000	26,000
I-33A Little Bourbeuse River	52	---	---	26,000	2,700	23,300	26,000
I-35A Brush Creek	69	---	---	26,000	3,300	22,700	26,000
I-38 Bourbeuse River	121	29,600	50	9,400	4,700	4,700	39,000
I-41 Benton Creek	28.8	7,700	50	2,600	1,900	700	10,300
Headwater reservoirs							
H-3 Dry Creek	9.2	1,850	50	900	670	230	2,750
H-4 Cabanne Course	8.2	---	---	2,080	650	1,430	2,080
H-5A Brady Creek	3.1	640	50	310	230	80	950
H-6 Birch Creek	10.4	---	---	2,760	730	2,030	2,760
H-8 Little Indian Creek	17.8	2,840	20	3,120	1,040	2,080	5,960
H-9 Bates Creek	8.0	1,430	50	810	620	190	2,240
H-10A Lost Creek	4.2	670	50	570	430	140	1,240
H-11A Winsell Creek	10.6	1,880	50	1,170	820	350	3,050
H-13A Boone Creek	21.1	4,170	50	1,410	1,060	350	5,580
H-25 Big River	13.3	700	10	1,960	870	1,090	2,660
H-31 Dry Fork Creek	6.2	---	---	1,760	510	1,250	1,760
H-40 Coonville Creek	3.9	---	---	900	380	520	900

* Excludes Washington Park and Irondale Reservoirs.
** Excludes Meramec Park Reservoir.

c. Water supply and water quality control. After allocation of storage requirements for flood control, approximately 1,570,000 acre-feet are available for joint-use purposes. Utilization of maximum available storage would involve extensive and costly railroad relocations at Pine Ford Reservoir. At Virginia Mines, the maximum possible storage would flood the commercially developed Meramec Caverns. Accordingly, joint-use storage at these two sites has been reduced a total of 186,000 acre-feet so as to obviate these conditions. Of the 1,384,000 acre-feet of storage remaining, 110,000 acre-feet are required for sediment storage in the 31 reservoirs. This amount reflects diminished sediment inflow to channels through improved land treatment measures. Net storage for joint-use purposes at each of the reservoirs, amounting to 1,274,000 acre-feet, is shown in TABLE 18. Requirements by reaches for water quality control, as shown in TABLE 19, reflect reductions in biochemical oxygen demand due to ponding in the upstream reservoirs.

TABLE 19
Summary of flows (in c.f.s.)
required for water quality control

Reach*	1970 summer	2020 summer	2070 summer
B-1	2	6	21
B-2	5	18	55
B-3	6	19	56
B-4	8	26	53
BG-1	30	57	80
BG-2	-	-	-
BG-3	-	-	-
BG-4	-	-	-
M-1	-	-	-
M-2	5	10	15
M-3	23	52	106
M-4	-	-	-
M-5	-	-	-
M-6	Flows required for Reach M-7 satisfy M-6 needs		
M-7	130	510	1,100

*Location of reaches shown on FIGURE 16, PAGE 47.

The capability of the reservoirs to assure water quality control is shown in TABLE 20. Total water needs are shown on FIGURE 20,

TABLE 20

Reservoir capability to assure water quality

Reach	Reservoirs contributing downstream flows to reach	Flow requirements (summer) 1970 (c.f.s.)	2020 (c.f.s.)	2070 (c.f.s.)	Assured flow below reservoir (c.f.s.)	Natural low flow below reservoir (c.f.s.)	Balance 1970 without reservoirs (c.f.s.)	Balance with reservoirs 1970 (c.f.s.)	2020 (c.f.s.)	2070 (c.f.s.)
BOURBEUSE SUB-BASIN										
1	I-38				1	0				
	I-21				12	2				
	I-35A				22	1				
	Cumulative flows	2	6	21	35	3	+ 1	+ 33	+ 29	+ 14
2	I-33A				19	1				
	Cumulative flows	5	18	55	54	4	- 1	+ 49	+ 36	- 1
3	I-32				20	1				
	Cumulative flows	6	19	56	74	5	- 1	+ 68	+ 55	+ 18
4	No. 29	8	26	53	213	11	+ 3	+ 205	+187	+160
BIG SUB-BASIN										
1	No. 9				101	5				
	I-30				7	0				
	Cumulative flows	30	57	80	108	5	- 25	+ 78	+ 51	+ 28
2	No. 5				101	4				
	Cumulative flows	---	---	---	101	4	+ 4	+ 101	+101	+101
3	Cumulative flows	---	---	---	209	9	+ 9	+ 209	+209	+209
4	2A				378	21	+ 21	+ 378	+378	+378
MERAMEC SUB-BASIN										
1	I-28				10	1				
Little Dry Fork	Cumulative flows	---	---	---	10	1	+ 1	+ 10	+ 10	+ 10
2	I-23				14	1				
Dry Fork	Cumulative flows	5	10	15	24	2	- 3	+ 19	+ 14	+ 9
3	27				88	5				
	I-41				4	1				
	Cumulative flows	23	52	106	116	8	- 15	+ 93	+ 64	+ 10
4	I-26				13	1				
Huzzah	I-14 (with 26)				18	3				
	I-15A				18	3				
	Total Reach 4	---	---	---	36	6	+ 6	+ 36	+ 36	+ 36
5	No. 17				614	131	+131	+ 614	+614	+614
	No. 40 (with 17)				721	155	+155	+ 721	+721	+721
6	Needs satisfied by Reach 7 requirements									
7	No. 29				213					
	No. 2A (with 9)				378					
	No. 40 (with 17)				721					
	Cumulative flows	130	510	1,100	1,312	200	+ 70	+1,182	+802	+212

AUGMENTED FLOW REQUIREMENTS, LOWER BASIN, FROM RESERVOIR SYSTEM. Based on total requirements for downstream flow regulation, both for water supply and quality control, the joint-use storage would provide for all water needs in the lower basin up to the year 2050. A shortage of 313 c.f.s. probably will exist during the period 2050 to 2070. In order to meet this deficiency, some reallocation of flood control storage or provision of additional storage will be required. With improved long-range weather forecasting, it probably will be found feasible to convert some flood control storage to multiple use for river regulation.

AUGMENTED FLOW REQUIREMENTS
LOWER BASIN
FROM RESERVOIR SYSTEM
IN BASIN PLAN

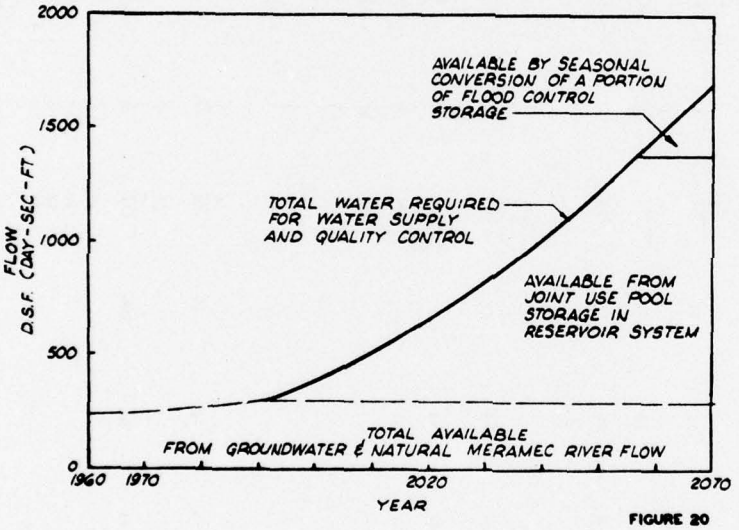
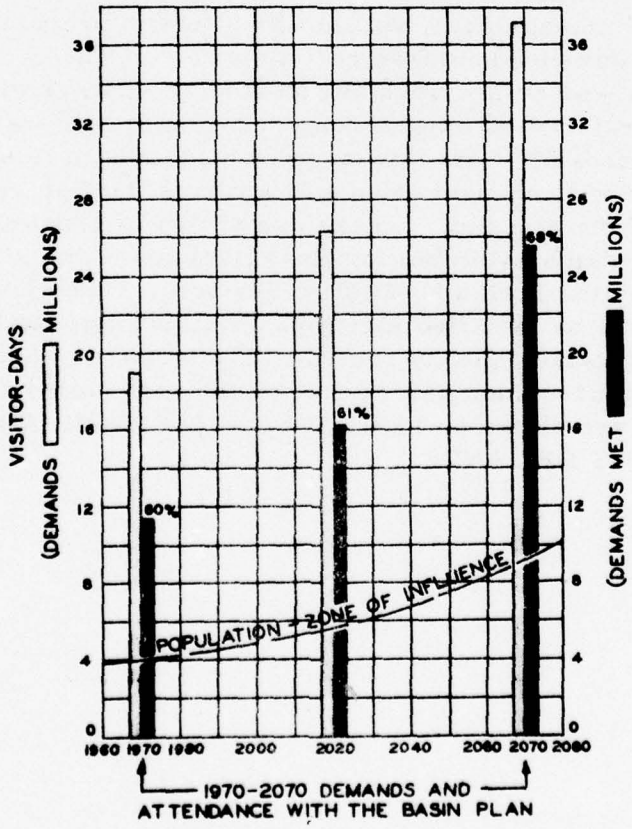


FIGURE 20

d. Recreation. The Meramec Basin has adequate land resources to meet the projected needs for land-based recreational activities. With the exception of a few private lakes and minor developments along the natural streams, water-based facilities are practically non-existent. The 31 reservoirs would provide a total water surface area of approximately 51,200 acres at normal pool level. Recreational demands and percentage of demands that can be met by the 31 reservoirs were estimated by the Corps of Engineers. These demands are based on population growth within the zone of influence and reflect increased demands generated by reservoirs over and above those projected without improvements. Reservoir-associated recreation demands, less hunting and fishing, are estimated at approximately 19,000,000 visitor-days by 1970, 26,500,000 by 2020, and in excess of 37,000,000 visitor-days by

the year 2070. The 31 reservoirs can support approximately 11,500,000 visitor-days by 1970, 16,000,000 visitor-days by 2020, and nearly 26,000,000 by the year 2070, provided adequate recreational facilities are constructed by Federal, State, and local governments, as well as private enterprise. The extent to which the reservoirs can meet these demands is shown on FIGURE 21, RESERVOIR ASSOCIATED RECREATION DEMANDS. Generally, the recreational facilities to be provided initially by the Corps of Engineers at the reservoirs include provisions for picnicking, swimming, camping, and boating. Fluctuation in reservoir levels which do not exceed 2 feet in any 24-hour period will have no appreciable effect on water-based recreation. Total drawdown of more than 6 feet during the intensive recreation season, April through October, will reduce the desirability of the reservoirs for recreation. However, the need for exceeding these limits during emergency drought periods is recognized. Further information on recreation related to reservoirs is contained in APPENDIX M.



RESERVOIR ASSOCIATED RECREATION DEMANDS (LESS HUNTING AND FISHING)

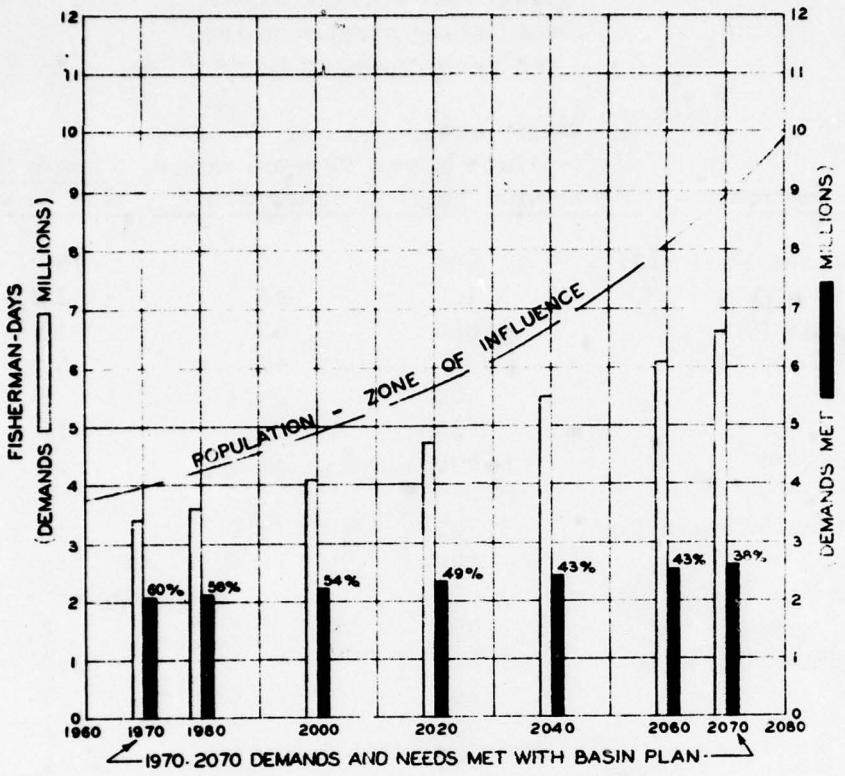
FIGURE 21

e. Fish and wildlife.

(1) Fishing demands. Total demands for fishing were estimated by the Corps of Engineers for 1970 and projected for selected years from 1970 through 2070. These demands are based on population growth within the zone of influence and reflect increased demands generated by the reservoirs, with attendant improved stream fishery, over and above the demands without improvements. Reservoir and stream fishermen demands are estimated at approximately 3,400,000 fisherman-days in 1970, 4,700,000 fisherman-days in 2020, and slightly less than 6,700,000 fisherman-days by the year 2070. Demands which can be met by the 31 reservoirs, angler-use sites, and improved channel flow are estimated at approximately 2,000,000 fisherman-days by 1970, 2,300,000 fisherman-days by 2020, and 2,700,000 fisherman-days by the year 2070. While the demands by fishermen will continue to increase over the years, fishery habitat, even under good management, will not increase in proportion to these demands. Multiple-level intakes recommended by the U. S. Fish and Wildlife Service will be provided at selected reservoirs to insure optimum temperature and oxygen content for improved warm-water fisheries downstream. Low-flow augmentation and provision of access points for boat and bank fishermen will enhance the fish and wildlife opportunities of the streams. There are shown in TABLE 21 stream miles below the dams available for float fishing and the stream flows recommended by the Fish and Wildlife Service. These low-flow requirements will be satisfied incidental to flow augmentation for water supply and water quality control. Projected demands and percentages of demands which can be met by the reservoirs and improved stream fishery are shown on FIGURE 22, RESERVOIR AND STREAM FISHERMAN-DAY DEMANDS.

TABLE 21
Reservoir surface areas,
float fishing stream miles,
and recommended flows

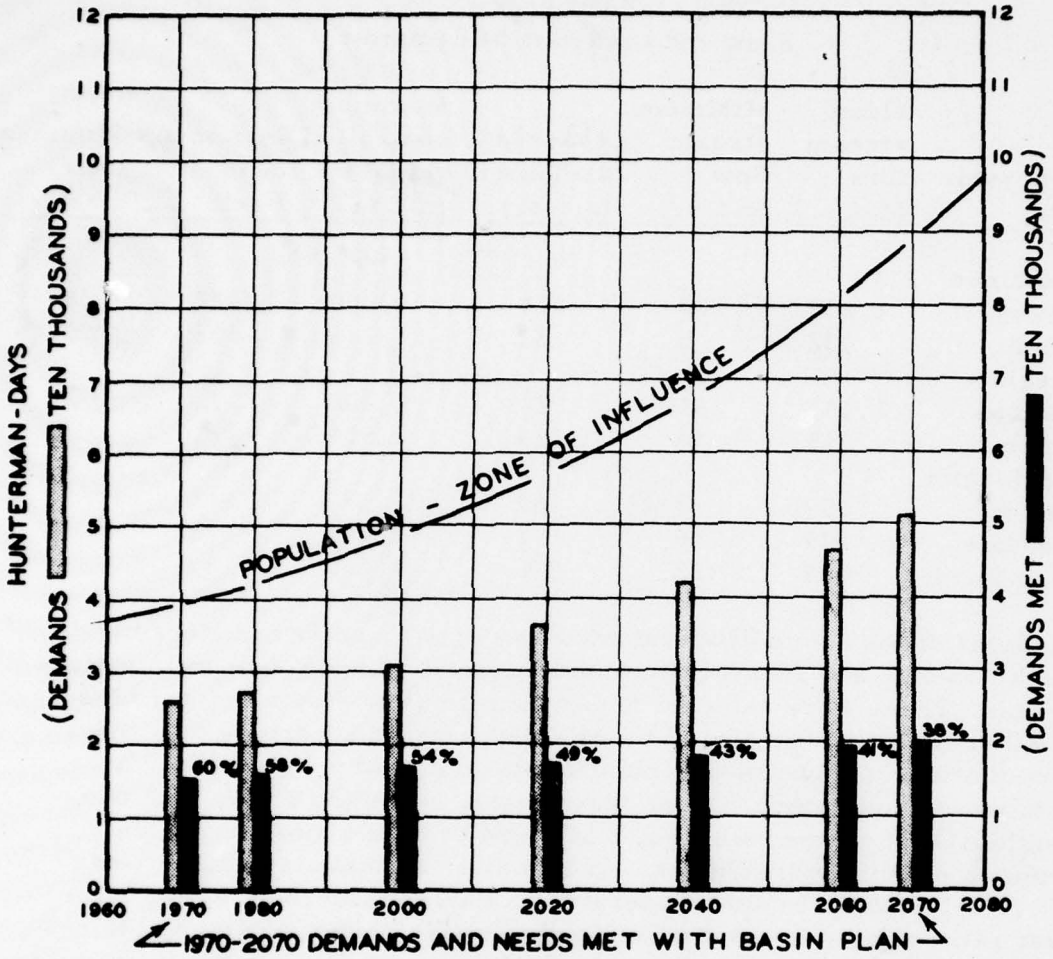
Reservoir	Water area (surface acres normal pool)	Stream miles below dam	Stream flow (c.f.s.) Min. low	Min. high
Meramec Park (17)	12,600	5	150	300
Salem (27)	3,400	48	25	100
Irondale (9)	4,600	68	10	30
Pine Ford (2A)	3,700	44	50	200
I-38	900	24.1	2	8
I-14	500	19	15	45
Union (29)	6,600	34.4	15	50
I-23	950	3.7	2	6
Washington Park (5)	3,700	5.0	25	100
I-15A	600	18.0	15	45
H-40	50	Not good habitat		0
I-32	2,050	1.5	2	5
Virginia Mines (40)	5,200	17.6	150	300
I-30	300	11.0	2	6
I-28	900	1.9	1	4
H-6	200	2.0	1	2
I-26	600	0.4	4	12
H-8	210	4.8	1	4
H-13A	50	9.0	1	3
H-4	100	0.3	1	4
H-9	70	2.7	1	4
H-25	115	8.5	2	5
H-10A	60	8.0	1	3
I-33A	1,450	5.0	1	4
I-35A	1,400	Not good habitat		0
H-11A	100	1.0	1	3
H-3	110	7.0	1	3
H-5A	40	Not good habitat		0
I-21	200	1.4	1	4
I-41	250	0.3	2	5
H-31	200	1.2	1	2



RESERVOIR AND STREAM FISHERMAN-DAY DEMANDS

FIGURE 22

(2) Hunting demands. The Corps of Engineers also estimated the total demands by hunters based on increasing population within the zone of influence and the percentage of demands which can be met by the reservoirs and stream-associated hunting. Demands are estimated at about 25,000 hunterman-days in 1970, 36,000 hunterman-days by 2020, and slightly in excess of 52,000 hunterman-days by 2070. Demands which can be met by the improvements under consideration are estimated at approximately 15,000 hunterman-days in 1970, 17,500 hunterman-days in 2020, and 20,000 hunterman-days by the year 2070. Demands met are based on additional lands made available for public hunting and improved management of wildlife habitat. Projected demands and percentages of demands that can be met are shown on FIGURE 23, RESERVOIR AND STREAM HUNTERMAN-DAY DEMANDS.



RESERVOIR AND STREAM HUNTERMAN-DAY DEMANDS

FIGURE 23

f. Water power. The seven main stream sites selected for consideration were investigated to determine whether stream flow characteristics were sufficient to warrant conventional power development. With the exception of flood control storage, no site was preempted for other purposes. Power development was based on utilization of the joint-use storage in each of these reservoirs. There are shown in TABLE 22 pertinent flow and head data at the damsites considered.

TABLE 22
Flow and head data at damsites

Reservoir site	Mean stream flow (c.f.s.)	Minimum stream flow (c.f.s.)	Assured discharge (c.f.s.)	Maximum controlled release (c.f.s.)	Maximum head (feet)	Minimum head (feet)
Meramec Park	1,248	134	614	9,000	122	34
Salem	132	5	88	1,045	108	32
Virginia Mines	1,447	155	721	10,400	43	25
Union	615	10	213	4,500	111	33
Washington Park	159	4	101	950	113	28
Irondale	174	5	101	1,020	96	34
Pine Ford	783	22	378	4,600	89	31

Analysis of the above data indicated that only three sites, Meramec Park, Salem, and Pine Ford, would be likely to show economic justification. These were selected for further detailed study to determine whether or not power should be retained in the final stages of project formulation. Conventional, pumped storage, and a combination of both were considered. Of the three sites, Meramec Park, with conventional and pumped storage, was found to be the most favorable from an economic standpoint. At this site, an installed capacity of 360,000 kilowatts would be operated at a 10 percent load factor. The best ratio of head to discharge for dependable power would be obtained if the joint-use pool drawdown were held to a minimum. The location and elevation of the pumped storage powerhouse have been determined by topography. In order to provide the required submergence of the impeller, tailwater drawdown is limited to elevation 663. See PLATE F-2, APPENDIX F. This drawdown will reduce regulated flow downstream from 614 c.f.s. to 350 c.f.s., which is not compatible with the needs of water supply and water quality control. Following review of the various plans and preliminary estimates of specific costs for each of the three sites, the Southwestern Power Administration stated that the power costs could not be recovered by the marketing agency now or in the foreseeable future. The Federal Power Commission agreed that justification is lacking at this time on which to base a request for authorization for construction of power facilities. The Commission advised that, since there is a potential market for future power at Meramec Park, Salem, and Pine Ford, power development

at these sites should be retained in the over-all basin plan for future consideration. Power features can be provided at these sites in the future at no substantial increase over the cost of concurrent construction. Further information on hydropower development is contained in APPENDIX F.

43. *LOCAL FLOOD PROTECTION*

a. General. The system of 31 reservoirs previously discussed will provide substantial reduction in flood flows in the Meramec Basin. Between the lowermost reservoirs on each tributary and Valley Park, 50-year frequency floods will be retained within banks. Flood problems will remain, however, in areas below these reservoirs with limited or no flood control storage and in the lower valley which will remain subject to backwater flooding by the Mississippi River. In the upper basin area, where flood damages are scattered over more than 600 miles of stream, levees or channel improvements generally are not feasible. Operation of reservoirs for low flow regulation will have incidental flood control effects. Remaining problems in these scattered areas will be eligible for consideration under continuing authorities for small projects.

b. Main stem protection. The effect of Mississippi River backwater at 52-foot stage on the St. Louis gage (maximum flood of record under future confined conditions) would flood a substantial area between mouth of the Meramec River and Valley Park. A system of levees and floodwalls to afford 200-year protection to the towns of Fenton, Valley Park, and Times Beach, and other potentially valuable industrial and residential areas was investigated. A lesser degree of protection was considered for the agricultural areas. Eighteen areas, covering some 9,300 acres, were studied for protection. Nine of these areas or portions thereof were eliminated for one or more of the following reasons:

(1) Length of levee too great in comparison to small acreage protected.

(2) Costly creek diversions or prohibitive pumping costs.

(3) Extensive commercial gravel deposits in or around perimeter of area.

For the remaining nine areas, levee and floodwalls are the only possible protective measures. There are shown in TABLE 23 the areas considered for further study. See PLATE 8 for locations.

TABLE 23
Areas selected for further study of local protection

Name and number of area		Land protected (acres)
Telegraph Road	(2)	325
Starling Airport	(4)	705
Butler Lakes	(5)	1,110
Fenton	(7)	70
West Watson Road	(8)	380
Weiss Airport	(9)	590
Valley Park	(11)	500
Peerless Park	(12)	900
Fox Creek	(17)	745

c. Flood plain zoning. The St. Louis County Planning Commission, in its comprehensive land-use plan, recommends preservation as permanent open space those lands subject to flooding, and zoning regulations are proposed to implement these plans so as to preclude development in the flood plain. Jefferson County has recently established a planning commission and has requested the Corps of Engineers to undertake flood plain studies. Without positive flood protection, development in the flood plain within the metropolitan St. Louis area will be discouraged. While local interests should make all possible effort to control or reduce hazardous occupation of flood plains, anticipated urbanization and industrial developments in the lower basin will create demands for use of additional lands in the flood plain in the future.

44. SUMMARY

The plan of 31 reservoirs, with 1,322,000 acre-feet of flood control storage; 1,274,000 acre-feet for flow regulation in the interest of water supply, water quality control, and improved stream flow for fishing; levee protection of 1,085 acres of agricultural land and 4,210 acres of potential urban and industrial land; and pertinent features for improvement of water-based recreation and preservation of fish and wildlife, has been selected for final study of costs, benefits, and economic justification.

SECTION VIII -
DESCRIPTION OF IMPROVEMENTS STUDIED IN DETAIL

45. GENERAL DESIGN FEATURES - RESERVOIRS

a. Reservoir sites. The topography of the Meramec Basin provides many potential reservoir sites. Sites listed in TABLE 18 of SECTION VII, and described in detail in this section, are the most desirable sites remaining after the process of elimination described in PARAGRAPH 41. Valley configuration and availability of borrow materials controlled the type of structures. A typical damsite has a comparatively steep rock bluff at one abutment, with its base at or near the river's edge. The other abutment has a more gradual slope with shallow soil cover over good rock, making it suitable for location of a chute spillway. The soil cover deepens on the uplands and also to a lesser extent in the flood plain. Flood plain alluvium contains varying amounts of pervious and impervious soils. The combination of earth embankment and chute-type spillway fits this typical site well. The shallow soil cover on the abutment slopes allows optimum location of simple conduit-type rock-founded outlet structures. The sites are underlain by strong rocks that are horizontally bedded and which contain no known weak strata. The principal geologic problems reported involve water-holding capabilities of the rock foundations. Solutions considered include programs of curtain grouting and concrete fill of cavernous openings. Further design details are contained in APPENDICES D, E, and G. The effect of reservoirs on caves is described in APPENDIX P.

b. Dams. All dams will be of the rolled-earth type. The presence of varied alluvial soils near the site allows construction of an economical zoned earth embankment. The top width of embankments will be 35 feet for main stream dams, 30 feet for tributary stream dams, and 20 feet for headwater dams. Slopes of the outer pervious zone are generally 1 on 3 and not less than 1 on 2.5. At most sites, shallow abutment rock requires a minimum of excavation and provides an excellent foundation for the chute-type spillway. Rock is readily reached by standard excavation methods. The impervious cutoff method was chosen for positive assurance of underseepage control. It also affords an opportunity to examine the bedrock surface and perform any necessary grouting across the dam axis. Any

limited rock excavation will be incorporated into the pervious zones or used for slope protection of the embankment. A normal grout curtain will be provided. The presence of pervious soils in the alluvium requires some seepage control. A drainage blanket will be provided in the downstream dam section. Minimum freeboard of 5 feet will be provided at the main stream and tributary stream reservoirs, with variable freeboards as shown in TABLE 27 for headwater reservoirs.

c. Spillways. A comparative study was made to determine the economical proportions of spillway and the interrelated maximum reservoir water surface and top elevation of dam. The spillway design flood was routed through the reservoir above static-full-pool for various spillway crest lengths. Based on an economic analysis of spillway lengths versus additional height of dam embankment, a spillway crest length of 200 feet was selected for the seven main stream reservoirs and a 50-foot crest length for nine of the tributary stream reservoirs. Three of the tributary stream reservoirs will have detached grassed spillways with a concrete apron on the crest and will vary in width from 365 feet to 1,100 feet. Spillways of the 12 headwater reservoirs will be earth or concrete chute and will vary in width from 75 feet to 250 feet. Slope and length of spillways are dictated by topography. Ungated spillways are selected for the following reasons: the cost of gated structures is greater than increased cost of earth embankment for the higher dam required with ungated spillways; operation and maintenance costs are substantially less than for gated structures; and cost of additional lands required is not a major item since the area is relatively undeveloped. Training walls are designed to contain the spillway design flood discharge with 2 feet of freeboard. Stilling basins are provided at all the main stream and at 9 of the 12 tributary stream dams. Reservoirs I-28, I-32, and I-21 have earth spillways without stilling basins. See APPENDIX C for detailed hydraulic design features.

d. Outlets. Outlet conduits are designed to carry diversion during construction and meet flow requirements downstream. Service gates are provided to control releases during flood periods to bankfull capacity of the river channel downstream of the dam and releases to satisfy the needs for water supply and water quality control. Multiple-level inlets are provided in the outlet structures at all main stream and tributary stream reservoirs to control the temperature and dissolved oxygen content of discharges for improved downstream fishery.

e. Method of operation. All of the 31 reservoirs will be operated for multiple-purpose uses. Twenty-one of the reservoirs

have flood control storage and will be operated specifically for Meramec Basin floods. Releases from the flood control pools will be limited to non-damaging flows downstream. Operation for Meramec River floods generally would be beneficial to Mississippi River flood control due to general coincidence of flood periods. Storage is provided in 18 of the reservoirs to meet downstream requirements for water supply and water quality control. Reservoirs will be drawn down for water supply and water quality control in proportion to downstream needs and storage available. Releases will be held to the minimum necessary in order to maintain reservoir stages as high as possible for recreational use. Low-flow regulation will, in addition to meeting the downstream needs for water supply and water quality control, improve fish habitat and augment low flows in the interest of navigation on the Mississippi River. While no storage is provided in the 12 headwater reservoirs for low-flow regulation, they will be so operated as to augment inflow to downstream reservoirs during critical drought periods.

f. Recreation. Facilities for public recreational use at reservoirs are provided in accordance with Section 4 of the Flood Control Act approved 22 December 1944, as amended. A joint report prepared by the Bureau of Outdoor Recreation and National Park Service defined the scope of development required to meet the initial impact of visitation at each reservoir. The comparative recreational quality of each of the reservoirs was evaluated based on the assumption that the entire system would be in operation. Requirements for public use and scope of initial development were determined for each of the reservoirs. After determining the facilities to be provided by the Corps of Engineers initially, and additional facilities to meet future needs as they develop, the Missouri State Park Board ascertained what developments could be assumed by that agency. Initial recreational developments provided by the Corps of Engineers include access and circulation roads, boat launching ramps, parking areas, picnicking and tent camp sites, beach areas, and provisions for potable water and sanitary facilities. TABLE 24 shows initial recreation developments proposed at each of the 31 reservoirs. Facilities for typical picnic units and tent camp spaces consist of a picnic table with concrete pad and a barbecue brazier. A picnic shelter, central washhouse with showers, provision of potable water and distribution system, sanitary facilities, and access road and parking area will be provided for groups of picnic units and tent camp spaces as appropriate.

TABLE 24
Initial recreation developments proposed

Project	Boat launching ramps (2-lane)	Picnic units	Tent camp spaces	Acres of parking area	Beaches (500-2,000 feet of lake frontage)
Meramec Park	12	450	400	15.0	3
Salem	2	85	90	2.0	3
Irondale	2	100	90	2.0	3
Pine Ford	3	200	180	3.0	3
I-38	1	70	60	1.5	2
I-14	1	35	30	0.75	2
Union	3	170	150	4.0	3
I-23	1	40	35	0.75	2
Washington Park	1	30	25	0.75	3
I-15A	1	20	20	0.33	2
H-40	1	10	10	0.33	0
I-32	1	20	20	0.33	2
Virginia Mines	10	220	200	3.00	3
I-30	1	20	20	0.33	2
I-28	2	30	30	0.50	2
H-6	1	15	15	0.33	0
I-26	2	30	30	0.50	2
H-8	1	15	15	0.33	0
H-13	1	20	20	0.33	1
H-4	1	10	10	0.33	0
H-9	1	15	15	0.33	0
H-25	1	10	10	0.33	0
H-10	1	10	10	0.33	0
I-33A	1	20	20	0.33	2
I-35A	1	20	20	0.33	2
H-11	1	10	10	0.33	0
H-3	1	15	15	0.33	0
H-5	1	15	15	0.33	0
I-21	1	15	15	0.33	0
I-41	1	20	20	0.33	2
H-31	1	15	15	0.33	0

g. Fish and wildlife. The U. S. Fish and Wildlife Service has indicated that at certain reservoirs releases would be too cold and too low in oxygen concentration to sustain the warm-water species fishery currently existing in these streams. Furthermore, there is not sufficient storage of cold water to carry trout fishery over the long and hot summer periods. Consequently, the Fish and Wildlife Service and the Missouri Conservation Commission recommended installation of multiple-level intakes for outlet structures at these dams. This would insure withdrawal of water above the thermocline at all seasons and sufficient oxygen concentration to provide optimum temperature and quality to not only continue but enhance downstream fishery. The Fish and Wildlife Service also recommends certain flow requirements to enhance downstream fishery. In addition, the Fish and Wildlife Service recommended a total of 26 angler-use sites for fisherman and hunter access, located along the downstream portions below the reservoirs. Seventeen of the sites will be located at points with road access; the remainder will have access by water only. Basic facilities to be provided at these sites are a boat launching ramp, parking area and access road (for road access sites only), comfort station, potable water, and related picnic and tent camp facilities. Subimpoundments for wildlife management were considered but were not found feasible because of the location of the reservoirs in relation to waterfowl flight patterns. No recommendations were made by the Fish and Wildlife Service or the U. S. Forest Service for preservation of timber in the upper levels of the flood control pools.

h. Land requirements. The land requirements for all reservoirs are based on the 1962 joint Department of the Interior-Department of Army real estate acquisition policy. All lands below the top flood control pool elevation (spillway crest) plus an additional 300 feet measured horizontally therefrom will be acquired in fee. This will provide adequate freeboard for surcharge, bank erosion, and wave action, except for reservoirs 2A, I-15A, and I-38 where additional lands are needed to meet project purpose requirements. Adequate lands will also be provided for public access and public use facilities proposed for initial development and to meet the anticipated future needs. Recommendations for these purposes have been received from the Bureau of Outdoor Recreation, National Park Service, and U. S. Forest Service and are contained in APPENDICES M and N. Lands will also be provided in mitigation of losses to wildlife habitat substantially as recommended by the U. S. Fish and Wildlife Service in APPENDIX O. Land requirements are tabulated as to purpose and present use in APPENDIX E.

i. Relocations. The reservoirs will require relocation and alteration to highways, roads, pipelines, power and telephone lines, and cemeteries. Road relocations and alterations will be constructed 3 feet above top of flood control pool, based on infrequency of spillway operation. Facilities will be abandoned where practicable and less costly than relocations.

46. MAIN STREAM RESERVOIRS

As discussed in SECTION VII, seven main stream reservoirs were selected as best suited to meet the immediate and projected water needs of the basin. The locations of these reservoirs are shown on PLATES 4, 5, 6, and 7, and pertinent data are contained in TABLE 25.

a. Pine Ford Reservoir (2A).

(1) Location. Dam located at mile 43.8 on Big River, about 45 miles southwest of St. Louis. Total drainage at damsite is 788 square miles. At normal pool, reservoir would extend 24 miles, with a surface area of 3,700 acres. The nearest large town is DeSoto, 8 miles east of the head of the pool. Access would be provided by State Highway Y, connecting to Route 30 (5 miles northwest), and by Route 21 from DeSoto.

(2) Features. The earth dam would be 141 feet high with a crest length of 2,070 feet at elevation 637.0 m.s.l. The chute spillway, 200 feet wide at elevation 595, would have a capacity of 185,200 c.f.s. at the maximum surcharge of 37 feet. At maximum spillway stage, the pool would flood 15,500 acres. At spillway crest, elevation 595, the pool area would be 8,500 acres. Two conduits 6'-3" x 11'-6" with tractor gates would have a capacity of 3,940 c.f.s. with pool elevation 561 for passage of within bank flows, and 378 c.f.s. at pool elevation 531 for low-water releases. Flood control storage of 196,700 acre-feet (4.68 inches of runoff) would be provided between elevations 595 and 561, with 76,300 acre-feet of joint-use storage between elevations 561 and 531 m.s.l. The minimum pool area at elevation 531 would be 1,300 acres.

(3) Effects. Flood control storage would hold the 100-year frequency flood at Pine Ford damsite to non-damaging stages and would afford protection to 43 miles of Big River valley below the damsite. The combined effect of Pine Ford and the Union and Meramec Park Reservoirs, described below, would hold the 200-year

TABLE 25
Main stream reservoir data sheet

	Pine Ford (2A)	Washington Park (5)	Irondale (9)	Virginia Mines (40)	Meramec Park (17)	Salem (27)	Union (29)
Top dam elevation (m. s. l.)	637	737	887	592	736	1,039	682
Spillway crest elevation (m. s. l.)	595	706	860	556	701	1,008	651
Normal pool elevation (m. s. l.)	561	706	855	556	667	1,000	616
Minimum conservation pool elevation (m. s. l.) (100-year sediment capacity)	531	618	796	527	600	928	567
River bottom elevation (m. s. l.)	496	590	760	500	566	894	531
Pool areas (acres)							
Maximum spillway surcharge	15,500	5,500	8,000	9,800	35,000	6,500	22,500
Flood control pool	8,500	-	5,100	-	27,500	4,100	16,600
Normal pool	3,700	3,700	4,600	5,200	12,600	3,400	6,600
Minimum conservation pool	1,300	400	500	1,400	1,500	400	1,000
Dam dimensions							
Crest length (feet)	2,070	2,770	4,050	2,190	2,550	2,090	3,720
Base width (feet)	982	917	722	526	978	1,010	878
Volume (cubic yard)	9,189,000	5,016,000	1,273,000	1,300,000	3,380,000	3,428,000	2,597,000
Spillway							
Type	Chute	Chute	Chute	Chute	Chute	Chute	Chute
Length (feet)	200	200	200	200	200	200	200
Capacity (c. f. s.)	185,200	108,400	82,900	139,800	132,200	108,400	108,400
Maximum surcharge (feet)	37	26	22	31	30	26	26
Outlets*							
Number, size	2 - 6'3"x11'6"	1 - 5'3"x6'6"	1 - 5'3"x6'6"	4 - 6'9"x12'0"	3 - 6'9"x12'0"	1 - 5'3"x6'6"	2 - 6'0"x11'0"
Maximum controlled discharge (c. f. s.)	3,940	800	875	8,740	7,540	875	3,770
Minimum controlled discharge (c. f. s.)	378	105	101	721	614	88	213

*Outlets, controlled by tractor gates, are sized for diversion and have capacities exceeding bankfull capacity and minimum flow requirements.

frequency flood in Meramec River above Pacific to non-damaging stages. Pine Ford operated in conjunction with three upstream reservoirs in the Big River Basin would provide an ultimate increase of 357 c.f.s. over the recorded low flow of 21 c.f.s. in Big River, or about 25 percent of the ultimate increase in low-flow needs of the lower Meramec River. The normal pool of 3,700 acres with 60 miles of shoreline would be available for recreational use with small drawdown in normal years and an eventual maximum drawdown of 30 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 15,100 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 4,600 acres, comprising 800 acres in replacement of flooded land in Washington State Park, 1,100 acres for initial recreational developments, and 2,700 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 5.7 miles of new roads and improving 2.7 miles of existing roads. There are two 10-inch parallel oil lines owned by the Gulf Refining Company which would be inundated by the reservoir. About 2,400 feet of this dual line would require alteration to maintain present service. Approximately 40 miles of power distribution lines and 20 miles of telephone lines will require alteration. It is planned to relocate 75 graves affected by the reservoir.

b. Washington Park Reservoir (5).

(1) Location. Dam located on Mineral Fork 5 miles above its confluence with the Big River near Washington State Park. Drainage area at damsite is 160 square miles. Reservoir would extend 12 miles, with a surface area of 3,700 acres at normal pool. The nearest large town to the reservoir is DeSoto, which is about 12 miles east of the damsite. Potosi is about 8 miles south of the upper reaches of the reservoir. Access to the reservoir area would be by State Highway 47, which connects to Route 30 about 20 miles to the northwest and to Potosi 10 miles to the south, and by Route 21 to DeSoto.

(2) Features. The earth dam would be 147 feet high with a crest length of 2,770 feet at elevation 737.0 m.s.l. The chute spillway, 200 feet wide at elevation 706, would have a capacity of

108,400 c.f.s. at the maximum surcharge of 26 feet. At maximum spillway stage, the pool would flood 5,500 acres. At spillway crest, elevation 706, the pool area would be 3,700 acres. A conduit 5'-3" x 6'-6" with tractor gates would have a capacity of 800 c.f.s. with pool elevation 706 for passage of within-bank flows, and 105 c.f.s. at pool elevation 618 for low-water releases. No flood control storage would be provided. Joint-use storage between elevations 706 and 618 is 141,600 acre-feet. The minimum pool area at elevation 618 would be 400 acres.

(3) Effects. Washington Park Reservoir would provide an ultimate increase of 97 c.f.s. over the recorded low flow of 4 c.f.s. in Mineral Fork, or about 27 percent of the ultimate low-flow increase from Pine Ford. The normal pool of 3,700 acres with 55 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual drawdown of 88 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 6,000 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,100 acres, comprising 500 acres for initial recreational developments and 600 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 5.9 miles of new roads and improving 3.4 miles of existing roads. There are approximately 12 miles of power distribution lines and 7 miles of telephone lines which will require alteration. No cemeteries would be affected by the reservoir.

c. Irondale Reservoir (9).

(1) Location. Dam located on the upper Big River at mile 117.1. Drainage area at damsite is 175 square miles. Reservoir would extend 10 miles, with a surface area of 4,600 acres at normal pool. The nearest large town to the reservoir is Flat River, which is about 10 miles east of the damsite. Access to the reservoir area would be by State Highway 21 to the north and Route M to Flat River.

(2) Features. The earth dam would be 127 feet high, with a crest length of 4,050 feet, which includes 2,000 feet of dike, at elevation 887.0 m.s.l. The chute spillway, 200 feet wide at elevation 860, would have a capacity of 82,900 c.f.s. at the maximum surcharge of 22 feet. At maximum spillway stage, the pool would flood 8,000 acres. At spillway crest, elevation 860, the pool area would be 5,100 acres. A conduit 5'-3" x 6'-6" with tractor gates would have a capacity of 875 c.f.s., with pool elevation 855 for passage of within-bank flows and 101 c.f.s. at pool elevation 796 for low-water releases. Flood control storage of 23,900 acre-feet (2.56 inches of runoff) would be provided between elevations 860 and 855, with 131,300 acre-feet of joint-use storage between elevations 855 and 796. The minimum pool area at elevation 796 would be 500 acres.

(3) Effects. Flood control storage would hold the 10-year frequency flood at Irondale damsite to non-damaging stages and alleviate flood damages in 42 miles of Big River valley above Pine Ford Reservoir. It will provide an ultimate increase of 96 c.f.s. over the recorded low flow of 5 c.f.s. at the site, or about 26 percent of the ultimate low-flow increase from Pine Ford. The normal pool of 4,600 acres with 65 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 59 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 8,500 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,900 acres, comprising 800 acres for initial recreational developments and 1,100 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 5.7 miles of new roads and improving 3.3 miles of existing roads. There are approximately 7 miles of power distribution lines and 5 miles of telephone lines which will require alteration. It is planned to relocate 20 graves affected by the reservoir.

d. Virginia Mines Reservoir (40).

(1) Location. Dam located at mile 82.5 on the Meramec River, approximately 50 miles southwest of St. Louis. Total drainage

area at damsite is 1,748 square miles, of which 240 square miles are below Meramec Park damsite. Reservoir would extend 20 miles, with a surface area of 5,200 acres at normal pool. Four of the larger towns in the basin, Pacific, Union, St. Clair, and Sullivan, are within a 15-mile radius of the reservoir. Access to the reservoir area would be by Route K, 5 miles from St. Clair, Missouri, on U. S. Highway 66.

(2) Features. The earth dam would be 92 feet high, with a crest length of 2,190 feet at elevation 592 m.s.l. The chute spillway, 200 feet wide at elevation 556, would have a capacity of 139,800 c.f.s. at the maximum surcharge of 31 feet. At maximum spillway stage, the pool would flood 9,800 acres. At spillway crest, elevation 556, the pool area would be 5,200 acres. Four conduits 6'-9" x 12'-0" with tractor gates would have a capacity of 8,740 c.f.s. with pool elevation 556 for passage of within bank flows, and 721 c.f.s. at pool elevation 527 for low-water releases. No flood control storage would be provided. There would be 101,300 acre-feet of joint-use storage between elevations 556 and 527 m.s.l. The minimum pool area at elevation 527 would be 1,400 acres.

(3) Effects. Virginia Mines operated with eight upstream reservoirs in the Meramec Basin would provide an ultimate increase of 566 c.f.s. over the recorded low flow of 155 c.f.s. in the Meramec River at the site, or about 40 percent of the ultimate low-flow needs of the lower Meramec River. The normal pool of 5,200 acres with 70 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 29 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 13,400 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 5,100 acres, comprising 1,500 acres for initial recreational developments and 3,600 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 3.5 miles of new roads and improving 2.2 miles of existing roads. There are approximately 30 miles of power distribution lines and 18 miles of telephone lines which will require alteration. It is planned to relocate 60 graves affected by the reservoir.

e. Meramec Park Reservoir (17).

(1) Location. Dam located at mile 107.5 on the Meramec River, approximately 65 miles southwest of St. Louis. Drainage area at damsite is 1,508 square miles. Reservoir would extend 40 miles, with a surface area of 12,600 acres. The nearest large town to the proposed dam is Sullivan, Missouri, which is about 4 miles west of the upper end of the reservoir. Access to the reservoir area would be by State Highway 155, about 5 miles from Sullivan where it connects to U. S. Highway 66.

(2) Features. The earth dam would be 170 feet high, with a crest length of 2,550 feet at elevation 736.0 m.s.l. The chute spillway, 200 feet wide at elevation 701, would have a capacity of 132,200 c.f.s. at the maximum surcharge of 30 feet. At maximum spillway stage, the pool would flood 35,000 acres. At spillway crest, elevation 701, the pool area would be 27,500 acres. Three conduits 6'-9" x 12'-0" with tractor gates would have a capacity of 7,540 c.f.s. with pool elevation 667 for passage of within-bank flows, and 614 c.f.s. at pool elevation 600 for low-water releases. Flood control storage of 581,600 acre-feet (7.24 inches of runoff) would be provided between elevations 701 and 667, with 400,200 acre-feet of joint-use storage between elevations 667 and 600 m.s.l.

(3) Effects. Flood control storage would hold the standard project frequency flood at Meramec Park damsite to non-damaging stages. The combined effect of Meramec Park, Pine Ford, and Union Reservoirs would hold the 200-year frequency flood in Meramec River above Pacific to non-damaging stages. Meramec Park would provide an ultimate increase of 483 c.f.s. over the recorded low flow of 131 c.f.s. at the site, or about 85 percent of the ultimate low-flow increase from Virginia Mines. The normal pool of 12,600 acres with 175 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 67 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 39,300 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 9,400 acres, comprising 1,300

acres in replacement of flooded land in Meramec State Park and Huzzah Wildlife Area, 3,700 acres for initial recreational developments, and 4,400 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 18.5 miles of new roads and improving 4.5 miles of existing roads. There are two 10-inch parallel oil lines owned by the Gulf Refining Company which would be inundated by the reservoir. About 2,550 feet of this dual line would require alteration to maintain present service. There are approximately 100 miles of power distribution lines and 70 miles of telephone lines which will require alteration. It is planned to relocate 350 graves affected by the reservoir.

f. Salem Reservoir (27).

(1) Location. Dam located at mile 190.6 on the Meramec River. Drainage area at damsite is 175 square miles. Reservoir would extend 12 miles, with a surface area of 3,400 acres at normal pool. The nearest large town to the proposed reservoir is Salem, which is about 10 miles southwest of the head of the reservoir. Access to the reservoir area would be provided by State Highway 19, which connects to U. S. Highway 66 about 30 miles to the north at Cuba.

(2) Features. The earth dam would be 145 feet high, with a crest length of 2,090 feet at elevation 1,039 m.s.l. The chute spillway, 200 feet wide at elevation 1,008, would have a capacity of 108,400 c.f.s. at the maximum surcharge of 26 feet. At maximum spillway stage, the pool would flood 6,500 acres. At spillway crest, elevation 1,008, the pool area would be 4,100 acres. One conduit 5'-3" x 6'-6" with tractor gates would have a capacity of 875 c.f.s. with pool elevation 1,000 for passage of within bank flows, and 88 c.f.s. at pool elevation 928 for low-water releases. Flood control storage of 30,000 acre-feet (3.22 inches of runoff) would be provided between elevations 1,008 and 1,000, with 125,200 acre-feet of joint-use storage between elevations 1,000 and 928 m.s.l. The minimum pool area at elevation 928 would be 400 acres.

(3) Effects. Flood control storage would hold the 20-year frequency flood below the damsite to non-damaging stages and, together with I-41 and I-28, alleviate flood damages in the 40 miles of Meramec valley above Meramec Park Reservoir. Salem would provide an ultimate increase of 83 c.f.s. over the recorded low flow of 5 c.f.s. at the site,

or about 15 percent of the ultimate low-flow increase from Virginia Mines. The normal pool of 3,400 acres with 50 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 72 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 6,900 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 2,600 acres, comprising 700 acres for initial recreational developments and 1,900 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 6.8 miles of new roads. There are approximately 12 miles of power distribution lines and 10 miles of telephone lines which will require alteration. It is planned to relocate 120 graves affected by the reservoir.

g. Union Reservoir (29).

(1) Location. Dam located at mile 31.6 on the Bourbeuse River, approximately 55 miles west of the city of St. Louis. Drainage area at damsite is 754 square miles. Reservoir would extend 48 miles, with a surface area of 6,600 acres at normal pool. The nearest large town to the reservoir is Union, which is about 6 miles north of the damsite. Access to the reservoir area would be by Route UU, which connects to U. S. Highway 50 about 5 miles to the north. The towns of Union, Washington, St. Clair, and Sullivan are within a 15-mile radius of the reservoir.

(2) Features. The earth dam would be 151 feet high, with a crest length of 3,720 feet at elevation 682.0 m.s.l. The chute spillway, 200 feet wide at elevation 651, would have a capacity of 108,400 c.f.s. at the maximum surcharge of 26 feet. At maximum spillway stage, the pool would flood 22,500 acres. At spillway crest, elevation 651, the pool area would be 16,600 acres. Two conduits 6'-0" x 11'-0" with tractor gates would have a capacity of 3,770 c.f.s. with pool elevation 616 for passage of within bank flows, and 213 c.f.s. at pool elevation 567 for low-water releases. Flood control storage of 355,600 acre-feet (8.84 inches of runoff) would be provided between elevations

651 and 616, with 160,500 acre-feet of joint-use storage between elevations 616 and 567 m.s.l. The minimum pool area at elevation 567 would be 1,000 acres.

(3) Effects. Flood control storage would hold the standard project frequency flood at the damsite to non-damaging stages. The combined effect of Union, Pine Ford, and Meramec Park Reservoirs would hold the 200-year frequency flood in Meramec River above Pacific to non-damaging stages. Union operated in conjunction with four upstream reservoirs in the Bourbeuse Basin would provide an ultimate increase of 202 c.f.s. over the recorded low flow of 11 c.f.s. at the damsite, or about 14 percent of the ultimate low-flow needs of the lower Meramec River. The normal pool of 6,600 acres with 100 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 49 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 25,200 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 3,500 acres, comprising 1,900 acres for initial recreational developments and 1,600 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 6.1 miles of new roads and improving 3.1 miles of existing roads. There are approximately 80 miles of power distribution lines and 0.5 mile of telephone lines which will require alteration. It is planned to relocate 100 graves affected by the reservoir.

47. TRIBUTARY STREAM RESERVOIRS

Twelve tributary stream reservoirs, outlined in SECTION VII, were selected for detailed study. The locations of these reservoirs are shown on PLATE 7, and pertinent data are contained in TABLE 26.

TABLE 26
Tributary reservoir data sheet

	I-30	I-15A	I-14	I-26	I-41	I-23	I-28	I-32	I-33A	I-35A	I-21	I-38
Top dam elevation (m. s. l.)	811	867	916	1,046	898	965	1,124	728	797	809	916	880
Spillway crest elevation (m. s. l.)	790	834	881	1,026	874	941	1,112	718	777	786	904	857
Normal pool elevation (m. s. l.)	782	806	847	1,019	853	941	1,101	718	777	786	887	837
Minimum conservation pool elevation (m. s. l.) (100-year sediment capacity)	771	799	837	959	850	914	1,079	689	743	756	885	830
River bottom elevation (m. s. l.)	745	765	805	925	825	885	1,045	665	705	735	865	805
Pool areas (acres)												
Maximum spillway surcharge	1,150	2,700	2,100	1,200	800	1,200	2,100	2,250	1,900	2,100	1,000	5,500
Flood control pool	950	1,600	1,250	950	450	-	1,750	-	-	-	800	2,950
Normal pool	270	620	460	630	230	950	900	2,050	1,450	1,400	220	850
Minimum conservation pool	170	440	310	120	200	200	200	550	230	250	170	450
Dam dimensions												
Crest length (feet)	1,745	2,170	1,655	1,300	1,770	3,050	1,465	2,205	2,700	2,400	2,275	3,000
Base width (feet)	376	581	631	686	422	540	534	430	618	566	352	508
Volume (cubic yard)	365,000	1,080,000	963,000	981,000	412,000	846,000	339,000	654,000	1,002,000	862,000	417,000	769,000
Spillway												
Type	Chute	Chute	Chute	Chute	Chute	Chute	Earth	Earth	Chute	Chute	Earth	Chute
Length (feet)	50	50	50	50	50	50	625	1,100	50	50	365	50
Capacity (c. f. s.)	12,280	30,410	33,900	11,080	16,280	16,280	34,730	36,890	11,080	14,890	20,280	14,890
Maximum surcharge (feet)	16	28	30	15	19	19	7	5	15	18	7	18
Outlets*												
Size	4'3"x5'3"	8'0"x10'0"	8'0"x10'0"	4'9"x6'0"	4'9"x6'0"	5'3"x6'6"	5'6"x7'6"	6'3"x7'9"	5'6"x7'6"	6'6"x8'0"	4'9"x6'0"	8'0"x10'0"
Maximum controlled discharge (c. f. s.)	100	610	560	135	144	178	220	300	260	345	118	605
Minimum controlled discharge (c. f. s.)	7	18	18	13	4	14	10	20	19	22	1	12

*Outlets, controlled by tractor gates, are sized for diversion and have capacities exceeding bankfull capacity.

a. Terre Bleue Creek Reservoir (I-30).

(1) Location. Dam located on Terre Bleue Creek 11.6 miles above its confluence with the Big River at mile 87.8. Drainage area at damsite is 19.8 square miles. Reservoir would extend 2.5 miles, with a surface area of 270 acres at normal pool. The nearest large town to the reservoir is Flat River, which is about 10 miles southwest of the damsite. Farmington is about 10 miles south of the upper portion of the reservoir. Access to the reservoir area would be provided by Routes K and C. Route K connects with U. S. Highway 67 about 10 miles to the west at Bonne Terre.

(2) Features. The earth dam would be 66 feet high, with a crest length of 1,745 feet at elevation 811 m.s.l. The chute spillway, 50 feet wide at elevation 790, would have a capacity of 12,280 c.f.s. at the maximum surcharge of 16 feet. At maximum spillway stage, the pool would flood 1,150 acres. At spillway crest, elevation 790, the pool area would be 950 acres. One conduit 4'-3" x 5'-3" with tractor gate would have a capacity of 100 c.f.s. with pool elevation 782 for passage of within bank flows, and 7 c.f.s. at pool elevation 771 for low-water releases. Flood control storage of 2,700 acre-feet (2.56 inches of runoff) would be provided between elevations 790 and 782, with 2,900 acre-feet of joint-use storage between elevations 782 and 771. The minimum pool area at elevation 771 would be 170 acres.

(3) Effects. Flood control storage would hold the 10-year frequency flood at damsite to non-damaging stages and alleviate flood damages to 11.6 miles of creek valley. Reservoir I-30 would provide an ultimate increase of 7 c.f.s. over the recorded low flow of 0 c.f.s. in Big River, or about 2 percent of the ultimate low-flow increase from Pine Ford. The normal pool of 270 acres with 14 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 11 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 1,600 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 500 acres, comprising 100 acres for initial recreational developments and 400 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.1 mile of new roads and improving 0.6 mile of existing roads. There are approximately 4 miles of power distribution lines and 3 miles of telephone lines which will require alteration. No cemetery relocations are required.

b. Courtois Creek Reservoir (I-15A).

(1) Location. Dam located on Courtois Creek in Clark National Forest 19 miles above its confluence with Huzzah Creek, which joins the Meramec at mile 130.5. Drainage area at damsite is 122 square miles. Reservoir would extend 3 miles, with a surface area of 620 acres at normal pool. Access to the reservoir area would be provided by State Highway 8 which connects Steelville and Potosi. The reservoir is about midway between these two towns.

(2) Features. The earth dam would be 102 feet high, with a crest length of 2,170 feet at elevation 867 m.s.l. The chute spillway, 50 feet wide at elevation 834, would have a capacity of 30,410 c.f.s. at the maximum surcharge of 28 feet. At maximum spillway stage, the pool would flood 2,700 acres. At spillway crest, elevation 834, the pool area would be 1,600 acres. One conduit 8'-0" x 10'-0" with tractor gate would have a capacity of 610 c.f.s. with pool elevation 806 for passage of within-bank flows, and 18 c.f.s. at pool elevation 799 for low-water releases. Flood control storage of 29,600 acre-feet (4.55 inches of runoff) would be provided between elevations 834 and 806, with 3,600 acre-feet of joint-use storage between elevations 806 and 799 m.s.l. The minimum pool area at elevation 799 would be 440 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and alleviate flood damages to 14 miles of creek valley above Meramec Park Reservoir. Reservoir I-15A would provide an ultimate increase of 15 c.f.s. over the recorded low flow of 3 c.f.s. at damsite, or about 3 percent of the ultimate low-flow increase from Virginia Mines. The normal pool of 620 acres with 10 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 7 feet under extreme drought conditions. Construction and operation of the reservoir will afford employment opportunities to an economically depressed area.

(4) Land. Acquisition in fee of 2,550 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,900 acres, comprising 1,200 acres requested by the Forest Service, 100 acres for initial recreational developments, and 600 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 5.3 miles of new roads. There are approximately 1 mile of power distribution lines and 1 mile of telephone lines which will require alteration. No cemetery relocations will be required.

c. Huzzah Creek Reservoir (I-14).

(1) Location. Dam located in Clark National Forest on Huzzah Creek 24.7 miles above its confluence with the Meramec River at mile 130.5. Drainage area at damsite is 112 square miles. Reservoir would extend 3.5 miles, with a surface area of 460 acres at normal pool. The nearest large town to the reservoir is Steelville, which is about 20 miles northwest of the damsite. Access to the reservoir area would be provided by Route V, which connects with State Highway 49 about 2 miles west of the damsite, and by Route C to the east.

(2) Features. The earth dam would be 111 feet high, with a crest length of 1,655 feet at elevation 916 m.s.l. The chute spillway, 50 feet wide at elevation 881, would have a capacity of 33,900 c.f.s. at the maximum surcharge of 30 feet. At maximum spillway stage, the pool would flood 2,100 acres. At spillway crest, elevation 881, the pool area would be 1,250 acres. One conduit 8'-0" x 10'-0" with tractor gate would have a capacity of 560 c.f.s. with pool elevation 847 for passage of within bank flows, and 18 c.f.s. at pool elevation 837 for low-water releases. Flood control storage of 27,500 acre-feet (4.61 inches of runoff) would be provided between elevations 881 and 847, with 3,900 acre-feet of joint-use storage between elevations 847 and 837 m.s.l. The minimum pool area at elevation 837 would be 310 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at the damsite to non-damaging stages and alleviate flood damages to 19.7 miles of creek valley above Meramec Park Reservoir. Reservoir I-14 operated with one upstream

reservoir would provide an ultimate increase of 15 c.f.s. over the low flow of 3 c.f.s. at the damsite, or about 3 percent of the ultimate low-flow increase from Virginia Mines. The normal pool of 460 acres with 9 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 10 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 2,150 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation, National Park Service, and U. S. Forest Service have jointly recommended additional acquisition of 3,500 acres, comprising 1,400 acres requested by the Forest Service, 200 acres for initial recreational developments, and 1,900 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.9 mile of new roads. No cemetery relocations will be required.

d. West Fork - Huzzah Creek Reservoir (I-26).

(1) Location. Dam located on Huzzah Creek at mile 35.0 in Clark National Forest. Drainage area at damsite is 27 square miles. Reservoir would extend 3 miles, with a surface area of 630 acres at normal pool. The nearest large town to the dam would be Salem, which is about 18 miles west of the upper end of the reservoir. Access to the reservoir area would be provided by a public road which connects with State Highway 32 about 5 miles to the south.

(2) Features. The earth dam would be 121 feet high, with a crest length of 1,300 feet at elevation 1,046 m.s.l. The chute spillway, 50 feet wide at elevation 1,026, would have a capacity of 11,080 c.f.s. at the maximum surcharge of 15 feet. At maximum spillway stage, the pool would flood 1,200 acres. At spillway crest, elevation 1,026, the pool area would be 950 acres. One conduit 4'-9" x 6'-0" with tractor gate would have a capacity of 135 c.f.s. with pool elevation 1,019 for passage of within-bank flows, and 13 c.f.s. at pool elevation 959 for low-water releases. Flood control storage of 4,600 acre-feet (3.19 inches of runoff) would be provided between elevations 1,026 and 1,019, with 19,600 acre-feet of joint-use storage between elevations 1,019 and 959 m.s.l. The minimum pool area at elevation 959 would be 120 acres.

(3) Effects. Flood control storage would hold the 20-year frequency flood at the damsite to non-damaging stages and alleviate flood damages in the 5 miles of creek valley above I-14 Reservoir. Reservoir I-26 would provide an ultimate increase of 12 c.f.s. over the recorded low flow of 1 c.f.s. in Huzzah Creek, or about 80 percent of the ultimate low-flow increase from I-14. The normal pool of 630 acres with 15 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 60 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 1,600 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation, National Park Service, and U. S. Forest Service have jointly recommended additional acquisition of 1,500 acres. Since this reservoir is located in a wilderness-type area, with extensive public lands for wildlife recreation in the general vicinity, acquisition of only 100 acres initially is deemed warranted.

(5) Relocations. The reservoir will necessitate constructing 3.0 miles of new roads. There are approximately 4 miles of power distribution lines and 3 miles of telephone lines which will require alteration. It is planned to relocate 75 graves affected by the reservoir.

e. Benton Creek Reservoir (I-41).

(1) Location. Dam located on Benton Creek 0.9 mile above the confluence with the Meramec River at mile 175.7. Drainage area at damsite is 28.8 square miles. Reservoir would extend 2.5 miles, with a surface area of 230 acres at normal pool. The reservoir is within a 15-mile radius of the towns of Rolla, St. James, Steelville, and Salem. Access to the reservoir area would be by a public road which connects to State Highway 68 to the west about 5 miles from the damsite.

(2) Features. The earth dam would be 73 feet high, with a crest length of 1,770 feet at elevation 898 m.s.l. The chute spillway, 50 feet wide at elevation 874, would have a capacity of 16,280 c.f.s. at the maximum surcharge of 19 feet. At maximum spillway stage, the pool would flood 800 acres. At spillway crest, elevation 874, the

pool area would be 450 acres. One conduit 4'-9" x 6'-0" with tractor gate would have a capacity of 144 c.f.s. with pool elevation 853 for passage of within bank flows, and 4 c.f.s. at pool elevation 850 for low-water releases. Flood control storage of 7,700 acre-feet (5.02 inches of runoff) would be provided between elevations 874 and 853, with 700 acre-feet of joint-use storage between elevations 853 and 850 m.s.l. The minimum pool area at elevation 850 would be 200 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and with Salem Reservoir on Meramec River alleviate flood damage on 25 miles of Meramec valley above Meramec Park Reservoir. Reservoir I-41 would provide an ultimate increase of 3 c.f.s. over the recorded low flow of 1 c.f.s. in Benton Creek, or about 1 percent of the ultimate low-flow increase from Virginia Mines. The normal pool of 230 acres with 6 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 3 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 900 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 400 acres, comprising 100 acres for initial recreational developments and 300 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 2.9 miles of new roads. There are two 10-inch parallel oil lines owned by the Gulf Refining Company which would be inundated by the reservoir. About 2,450 feet of this dual line would require alteration to maintain present service. There are approximately 2 miles of power distribution lines and 2 miles of telephone lines which will require alteration. No cemeteries would be affected by the reservoir.

f. Little Dry Fork Reservoir (I-23).

(1) Location. Dam located at mile 2.3 on Little Dry Fork Creek, a tributary of Dry Fork which it enters 18.0 miles above the confluence of Dry Fork with the Meramec River at mile 167.8. Drainage area at damsite is 36 square miles. Reservoir would extend 3.5 miles, with a surface area of 950 acres at normal pool. The nearest large town to the reservoir is Rolla, Missouri, which is about

5 miles west of the reservoir. From Rolla, access to the reservoir area would be by Route BB.

(2) Features. The earth dam would be 80 feet high with a crest length of 3,050 feet at elevation 965 m.s.l. The chute spillway, 50 feet wide at elevation 941, would have a capacity of 16,280 c.f.s. at the maximum surcharge of 19 feet. At maximum spillway stage, the pool would flood 1,200 acres. At spillway crest, elevation 941, the pool area would be 950 acres. One conduit 5'-3" x 6'-6" with tractor gate would have a capacity of 178 c.f.s. with pool elevation 941 for passage of within-bank flows, and 14 c.f.s. at pool elevation 914 for low-water releases. No flood control storage is provided. Joint-use storage of 10,600 acre-feet would be provided between elevations 941 and 914. The minimum pool area at elevation 914 would be 200 acres.

(3) Effects. Reservoir I-23 would provide an ultimate increase of 13 c.f.s. over the recorded low flow of 1 c.f.s. in Little Dry Fork Creek, or about 2 percent of the ultimate low-flow increase from Virginia Mines. The normal pool of 950 acres with 15 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 27 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 1,700 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,200 acres, comprising 100 acres for initial recreational developments and 1,100 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.3 mile of new roads and alteration of 0.2 mile of existing roads. There are approximately 3 miles of power distribution lines, 0.3 mile of 33 KV transmission lines, and 3 miles of telephone lines which will require alteration. No cemeteries are affected by the reservoir.

g. Spring Creek Reservoir (I-28).

(1) Location. Dam located at mile 2.0 on Spring Creek, a tributary of Dry Fork which it enters 48 miles above its confluence with the Meramec River at mile 167.8. Drainage area at damsite is 44 square miles. Reservoir would extend 4 miles, with a surface area of 900 acres at normal pool. The nearest large town to the reservoir

is Salem, which is about 5 miles south of the head of the reservoir. Access to the reservoir area would be by State Highway 72 which connects the towns of Rolla and Salem.

(2) Features. The earth dam would be 79 feet high, with a crest length of 1,465 feet at elevation 1,124 m.s.l. The earth spillway, 625 feet wide at elevation 1,112, would have a capacity of 34,730 c.f.s. at the maximum surcharge of 7 feet. At maximum spillway stage, the pool would flood 2,100 acres. At spillway crest, elevation 1,112, the pool area would be 1,750 acres. One conduit 5'-6" x 7'-6" with tractor gate would have a capacity of 220 c.f.s. with pool elevation 1,101 for passage of within-bank flows, and 10 c.f.s. at pool elevation 1,079 for low-water releases. Flood control storage of 11,800 acre-feet (5.03 inches of runoff) would be provided between elevations 1,112 and 1,101, with 11,700 acre-feet of joint-use storage between elevations 1,101 and 1,079 m.s.l. The minimum pool area at elevation 1,079 would be 200 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and would alleviate flood damages in the lower 48 miles of Dry Fork Creek and, with I-41 and Salem, reduce flood damages in 18 miles of Meramec River above Meramec Park Reservoir. Reservoir I-28 would provide an ultimate increase of 9 c.f.s. over the low flow of 1 c.f.s. at the damsite, or about 2 percent of the ultimate low-flow increase from Virginia Mines. The normal pool of 900 acres with 18 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 22 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 2,900 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,600 acres, comprising 300 acres for initial recreational developments and 1,300 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 2.3 miles of new roads and improving 1.1 miles of existing roads. There are approximately 6 miles of power distribution lines and 5 miles of telephone lines which will require alteration. No cemeteries will need to be relocated.

h. Redoak Creek Reservoir (I-32).

(1) Location. Dam located on Redoak Creek 1.3 miles above its confluence with the Bourbeuse River at mile 83.0. Drainage area at damsite is 60 square miles. Reservoir would extend 7.5 miles, with a surface area of 2,050 acres at normal pool. The nearest large town to the reservoir is Owensville, which is about 10 miles west of the damsite. Access to the reservoir area would be by Route T which connects to U. S. Highway 50 at Rosebud about 2 miles to the north.

(2) Features. The earth dam would be 63 feet high, with a crest length of 2,205 feet at elevation 728 m.s.l. The earth spillway, 1,100 feet wide at elevation 718, would have a capacity of 36,890 c.f.s. at the maximum surcharge of 5 feet. At maximum spillway stage, the pool would flood 2,250 acres. At spillway crest, elevation 718, the pool area would be 2,050 acres. One conduit 6'-3" x 7'-9" with tractor gate would have a capacity of 300 c.f.s. with pool elevation 718 for passage of within-bank flows, and 20 c.f.s. at pool elevation 689 for low-water releases. No flood control storage is provided. Joint-use storage of 23,000 acre-feet is provided between elevations 718 and 689 m.s.l. The minimum pool area at elevation 689 would be 550 acres.

(3) Effects. Reservoir I-32 would provide an ultimate increase of 19 c.f.s. over the low flow of 1 c.f.s. in Redoak Creek, or about 9 percent of the ultimate low-flow increase from Union. The normal pool of 2,050 acres with 26 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 29 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities for a distressed area.

(4) Land. Acquisition in fee of 3,300 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 600 acres, comprising 200 acres for initial recreational developments and 400 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 1.4 miles of new roads and improving 0.5 mile of existing roads. There are approximately 5 miles of power distribution lines and 5 miles of telephone lines which will require alteration. No cemeteries are affected by the reservoir.

i. Little Bourbeuse River Reservoir (I-33A).

(1) Location. Damsite located on Little Bourbeuse River 5.1 miles above its confluence with the Bourbeuse River at mile 89.9. Drainage area at damsite is 52 square miles. Reservoir would extend 6 miles, with a surface area of 1,450 acres at normal pool. The nearest large town to the reservoir is Sullivan, which is about 15 miles east of the damsite. Access to the reservoir area would be by Route C which connects to U. S. Highway 66 at Bourbon about 8 miles southeast.

(2) Features. The earth dam would be 92 feet high, with a crest length of 2,700 feet at elevation 797 m.s.l. The chute spillway, 50 feet wide at elevation 777, would have a capacity of 11,080 c.f.s. at the maximum surcharge of 15 feet. At maximum spillway stage, the pool would flood 1,900 acres. At spillway crest, elevation 777, the pool area would be 1,450 acres. One conduit 5'-6" x 7'-6" with tractor gate would have a capacity of 260 c.f.s. with pool elevation 777 for passage of within bank flows, and 19 c.f.s. at pool elevation 743 for low-water releases. No flood control storage is provided. Joint-use storage of 23,300 acre-feet would be provided between elevations 777 and 743 m.s.l. The minimum pool area at elevation 743 would be 230 acres.

(3) Effects. Reservoir I-33A would provide an ultimate increase of 18 c.f.s. over the low flow of 1 c.f.s. in Little Bourbeuse River, or about 9 percent of the ultimate low-flow increase from Union. The normal pool of 1,450 acres with 22 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 34 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 2,500 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,000 acres, comprising 200 acres for initial recreational developments and 800 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 1.1 miles of new roads and improving 1.4 miles of existing roads. There are approximately 8 miles of power distribution lines and 6 miles of telephone lines which will require alteration. About 50 graves would require relocation.

j. Brush Creek Reservoir (I-35A).

(1) Location. Damsite located on Brush Creek 2.5 miles above its confluence with the Bourbeuse River at mile 105.3. Drainage area at damsite is 69 square miles. Reservoir would extend 7 miles, with a surface area of 1,400 acres. The towns of Cuba, Sullivan, St. James, Steelville, and Owensville are within a 15-mile radius of the reservoir area. Access to the reservoir would be by State Highway 19 which connects to U. S. Highway 66 at Cuba about 8 miles south.

(2) Features. The earth dam would be 74 feet high, with a crest length of 2,400 feet at elevation 809 m.s.l. The chute spillway, 50 feet wide at elevation 786, would have a capacity of 14,890 c.f.s. at the maximum surcharge of 18 feet. At maximum spillway stage, the pool would flood 2,100 acres. At spillway crest, elevation 786, the pool area would be 1,400 acres. One conduit 6'-6" x 8'-0" with tractor gate would have a capacity of 345 c.f.s. with pool elevation 786 for passage of within-bank flows, and 22 c.f.s. at pool elevation 756 for low-water releases. No flood control storage is provided. Joint-use storage of 22,700 acre-feet would be provided between elevations 786 and 756. The minimum pool area at elevation 756 would be 250 acres.

(3) Effects. Reservoir I-35A would provide an ultimate increase of 21 c.f.s. over the recorded low flow of 1 c.f.s. in Brush Creek, or about 10 percent of the ultimate low-flow increase from Union. The normal pool of 1,400 acres with 20 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 30 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 2,400 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,100 acres, comprising 200 acres for initial recreational developments and 900 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 3.1 miles of new roads and improving 0.7 mile of existing roads. There are approximately 11 miles of power distribution lines and 8 miles of telephone lines which will require alteration. No cemeteries would be affected by the reservoir.

k. Peavine Creek Reservoir (I-21).

(1) Location. Dam located at mile 1.5 on Peavine Creek, a tributary of Dry Fork Creek which it enters 15 miles above its confluence with the Bourbeuse River at mile 100.7. Drainage area of damsite is 23.5 square miles. Reservoir would extend 1 mile, with a surface area of 220 acres at normal pool. The nearest large town to the reservoir is Belle, which is about 5 miles north of the damsite. Access to the reservoir area would be by Route F about 3 miles east of State Highway 28.

(2) Features. The earth dam would be 51 feet high, with a crest length of 2,275 feet at elevation 916 m.s.l. The earth spillway, 365 feet wide at elevation 904, would have a capacity of 20,280 c.f.s. at the maximum surcharge of 7 feet. At maximum spillway stage, the pool would flood 1,000 acres. At spillway crest, elevation 904, the pool area would be 800 acres. One conduit 4'-9" x 6'-0" with tractor gate would have a capacity of 118 c.f.s. with pool elevation 887 for passage of within-bank flows, and 1 c.f.s. at pool elevation 885 for low-water releases. Flood control storage of 6,300 acre-feet (5.03 inches of runoff) would be provided between elevations 904 and 887, with 700 acre-feet of joint-use storage between elevations 887 and 885 m.s.l. The minimum pool area at elevation 885 would be 170 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at the damsite to non-damaging stages and alleviate flood damages in the 1.5 miles of Peavine Creek, 15 miles of Dry Fork Creek, and, together with I-38, in the 23 miles of Bourbeuse valley above Union Reservoir. Low-flow augmentation would be neglibible. The normal pool of 220 acres with 4 miles of shoreline would be available, with small drawdown in normal years and an eventual maximum drawdown of 2 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 1,500 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 400 acres, comprising 100 acres for initial recreational developments and 300 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 2 miles of new roads and improving 0.3 mile of existing road. There are approximately 3 miles of power distribution lines and 2 miles of telephone lines which will require alteration. No cemeteries are affected by the reservoir.

1. Bourbeuse River Reservoir (I-38).

(1) Location. Damsite located at mile 127.3 on the Bourbeuse River. Drainage area at damsite is 121 square miles. Reservoir would extend 4 miles, with a surface area of 850 acres. The reservoir is within easy access of the towns of Rolla and Cuba via State Highway 68 about 8 miles from St. James on U. S. Highway 66.

(2) Features. The earth dam would be 75 feet high, with a crest length of 3,000 feet at elevation 880 m.s.l. The chute spillway, 50 feet wide at elevation 857, would have a capacity of 14,890 c.f.s. at the maximum surcharge of 18 feet. At maximum spillway stage, the pool would flood 5,500 acres. At spillway crest, elevation 857, the pool area would be 2,950 acres. One conduit 8'-0" x 10'-0" with tractor gate would have a capacity of 605 c.f.s. with pool elevation 837 for passage of within-bank flows, and 12 c.f.s. at pool elevation 830 for low-water releases. Flood control storage of 29,600 acre-feet (4.58 inches of runoff) would be provided between elevations 857 and 837, with 4,700 acre-feet of joint-use storage between elevations 837 and 830 m.s.l. The minimum pool area at elevation 830 would be 450 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and, together with I-21, alleviate flood damages in the 50 miles of Bourbeuse River valley above the Union Reservoir. Reservoir I-38 would provide an ultimate increase of 10 c.f.s. over the low flow of 2 c.f.s. at damsite, or about 5 percent of the ultimate low-flow increase from Union. The normal pool of 850 acres with 15 miles of shoreline would be available for recreational use, with small drawdown in normal years and an eventual maximum drawdown of 7 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 4,700 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 1,300 acres, comprising 300 acres for initial recreational developments and 1,000 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 3.1 miles of new roads and improving 0.6 mile of existing roads. There are approximately 8 miles of power distribution lines and 6 miles of telephone lines which will require alteration. No cemeteries will be affected by the reservoir.

48. HEADWATER RESERVOIRS

Twelve headwater reservoirs, outlined in SECTION VII, were selected by the Corps of Engineers for detailed study. Dams were designed by the Soil Conservation Service, Department of Agriculture. Spillway capacities were derived from freeboard hydrographs. Additional information on design details is contained in PART 2, APPENDIX G. The locations of these reservoirs are shown on PLATE 7, and pertinent data are contained in TABLE 27.

a. Dry Creek Reservoir (H-3).

(1) Location. Dam located on Dry Creek 7.0 miles above its confluence with Big River at mile 32. Drainage area at damsite is 9.2 square miles. Reservoir would extend 1.5 miles, with a surface area of 100 acres at normal pool. The nearest large towns to the reservoir are DeSoto, which is about 6 miles southeast of the damsite, and Hillsboro, which is about 8 miles northeast of the damsite. Access to the reservoir area would be provided by a public road which connects to Route Y. Route Y connects with State Highway 21 in the vicinity of DeSoto.

(2) Features. The earth dam would be 43 feet high, with a crest length of 1,050 feet at elevation 635 m.s.l. The earth spillway, 185 feet wide at elevation 629, would have a capacity of 9,600 c.f.s. at the maximum surcharge of 6 feet. At maximum spillway stage, the pool would flood 270 acres. At spillway crest, elevation 629, the pool area would be 200 acres. One 36-inch diameter conduit with uncontrolled drop inlet would have a capacity of 205 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit provides for low-flow releases from joint-use pool. Flood control storage of 1,850 acre-feet (3.77 inches of runoff) would be provided between elevations 629 and 618, with 230 acre-feet of joint-use storage between elevations 618 and 615 m.s.l. The minimum pool area at elevation 615 would be 90 acres.

TABLE 27
Headwater reservoir data sheet

	H-3	H-9	H-4	H-40	H-25	H-5A	H-8	H-10A	H-6	H-11A	H-13A	H-31
Top dam elevation (m. s. l.)	635	955	683	685	1,054	555	723	1,015	543	824	818	895
Spillway crest elevation (m. s. l.)	629	948	673	675	1,044	549	717	1,006	536	818	811	885
Normal pool elevation (m. s. l.)	618	935	673	675	1,038	537	706	997	536	806	794	885
Minimum conservation pool elevation (m. s. l.) (100-year sediment capacity)	615	933	650	663	1,027	535	692	994	521	802	792	874
River bottom elevation (m. s. l.)	592	908	617	632	988	512	664	968	492	776	764	850
Pool areas (acres)												
Maximum spillway surcharge	270	210	130	60	180	100	350	120	280	270	550	260
Flood control pool	200	150	-	-	140	80	290	90	-	200	400	-
Normal pool	100	100	100	50	100	50	200	50	200	100	150	200
Minimum conservation pool	90	60	40	30	70	30	100	40	60	80	140	80
Dam dimensions												
Crest length (feet)	1,050	1,180	610	580	300	980	1,380	690	1,090	760	1,270	1,510
Base width (feet)	200	230	370	310	400	230	320	270	230	260	270	230
Volume (cubic yard)	90,200	154,900	102,800	144,400	79,600	38,200	360,300	138,000	168,000	29,000	240,200	170,500
Spillway												
Type	Earth	Earth	Chute	Chute	Chute	Earth	Earth ramp	Chute	Rock	Earth	Earth	Earth
Length (feet)	185	140	162	90	90	92	200	75	75	180	250	135
Capacity (c. f. s.)	9,600	7,800	10,000	5,775	6,620	3,345	17,200	3,775	4,400	9,400	13,500	6,500
Maximum surcharge (feet)	6.0	7.0	9.0	8.9	8.7	5.4	5.3	7.8	6.6	6.0	6.8	6.4
Outlets												
Size	36" dia.	36" dia.	36" dia.	12" dia.	24" dia.	24" dia.	24" dia.	24" dia.	24" dia.	24" dia.	24" dia.	36" dia.
Maximum controlled discharge (c. f. s.)	205	196	212	-	302	75	428	75	375	293	493	184

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and alleviate flood damages in the 7 miles of Dry Creek, including the town of Ware. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 100 acres with a shoreline of 3 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 3 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 440 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 400 acres, comprising 30 acres for initial recreational developments and 370 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.5 mile of new roads. Only minor relocations of power lines and telephone lines would be required. No cemeteries are affected by the reservoir.

b. Bates Creek Reservoir (H-9).

(1) Location. Dam located at mile 2.7 on Bates Creek, a tributary of Breton Creek which it enters about 7 miles above its confluence with Mineral Fork, a principal tributary of Big River, at mile 60.6. Drainage area at damsite is 8 square miles. Reservoir would extend 1 mile, with a surface area of 100 acres at normal pool. The nearest large town to the reservoir is Potosi, which is about 3 miles northeast of the reservoir. Access to the reservoir area would be by a public road which connects to Route P south of the reservoir.

(2) Features. The earth dam would be 47 feet high, with a crest length of 1,180 feet at elevation 955 m.s.l. The earth spillway, 140 feet wide at elevation 948, would have a capacity of 7,800 c.f.s. at the maximum surcharge of 7 feet. At maximum spillway stage, the pool would flood 210 acres. At spillway crest, elevation 948, the pool area would be 150 acres. One 36-inch diameter conduit with uncontrolled drop inlet would have a capacity of 196 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit is provided for low-flow releases from joint-use pool. Flood control storage of 1,430 acre-feet (3.35 inches of runoff) would be provided between elevations 948 and 935, with 190 acre-feet of joint-use storage between elevations 935 and 933 m.s.l. The minimum pool area at elevation 933 would be 60 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and alleviate flood damages in the 2.7 miles of Bates Creek and 7 miles of Breton Creek above Washington Park Reservoir. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 100 acres with a shoreline of 2 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 2 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 300 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 340 acres, comprising 20 acres for initial recreational developments and 320 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 1 mile of new roads. Only minor relocations of power and telephone lines will be required. No cemeteries are affected by the reservoir.

c. Cabanne Course (H-4).

(1) Location. Dam located on Cabanne Course 0.3 mile above its confluence with Big River at mile 81.2. Drainage area at damsite is 8.2 square miles. Reservoir would extend 1 mile, with a surface area of 100 acres at normal pool. The nearest large towns to the reservoir are Bonne Terre, which is about 3 miles southeast of the damsite, and Flat River, which is about 8 miles south of the head of the reservoir. Access to the reservoir area would be provided by Route E from Bonne Terre.

(2) Features. Dam would be 66 feet high, with a crest length of 610 feet at elevation 683 m.s.l. The concrete chute spillway, 162 feet wide at elevation 673, would have a capacity of 10,000 c.f.s. at the maximum surcharge of 9 feet. At maximum spillway stage, the pool would flood 130 acres. At spillway crest, elevation 673, the pool area would be 100 acres. One 36-inch diameter conduit with uncontrolled drop inlet would have a capacity of 212 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit is provided for low-flow releases from joint-use pool. No flood control storage would be provided. Joint-use storage of 1,430 acre-feet would be provided between elevations 673 and 650 m.s.l. The minimum pool area at elevation 650 would be 40 acres.

(3) Effects. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 100 acres with a shoreline of 3 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 23 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 380 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 440 acres, comprising 20 acres for initial recreational developments and 420 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.3 mile of new roads and 1 new bridge. Only minor relocations to power and telephone lines are required. No cemeteries are affected by the reservoir.

d. Coonville Creek Reservoir (H-40).

(1) Location. The damsite is located on Coonville Creek 0.1 mile above its confluence with Big River at mile 84.8. Drainage area at damsite is 3.9 square miles. Reservoir would extend 0.5 mile, with a surface area of 50 acres at normal pool. The nearest large towns to the reservoir are Bonne Terre, which is about 4 miles south of the damsite, and Flat River, which is about 8 miles south of the reservoir. Access to the reservoir area would be provided by a public road which connects to U. S. Highway 67 about 2 miles west.

(2) Features. The earth dam would be 53 feet high, with a crest length of 580 feet at elevation 685 m.s.l. The concrete chute spillway, 90 feet wide at elevation 675, would have a capacity of 5,775 c.f.s. at the maximum surcharge of 8.9 feet. At maximum spillway stage, the pool would flood 60 acres. At spillway crest, elevation 675, the pool area would be 50 acres. No drop inlet is provided. A 12-inch diameter conduit is provided for low-flow releases from joint-use pool. No flood control storage would be provided. Joint-use storage of 520 acre-feet would be provided between elevations 675 and 663 m.s.l. The minimum pool area at elevation 663 would be 30 acres.

(3) Effects. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 50 acres with a shoreline of 2 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 12 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 230 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 840 acres, comprising 10 acres for initial recreational developments and 830 acres to be reserved for future development or held in the wild state.

(5) Relocations. No relocations will be required.

e. Big River Reservoir (H-25).

(1) Location. Dam located at mile 134.5 on Big River in Clark National Forest. Drainage area at damsite is 13.3 square miles. Reservoir would extend 1.5 miles, with a surface area of 100 acres at normal pool. Access to the reservoir area would be provided by a public road which connects to State Highway 32 about 2 miles south of the reservoir. The towns of Viburnum and Belleview are about 10 miles west and east, respectively, from the reservoir.

(2) Features. The earth dam would be 66 feet high, with a crest length of 300 feet at elevation 1,054 m.s.l. The concrete chute spillway, 90 feet wide at elevation 1,044, would have a capacity of 6,620 c.f.s. at the maximum surcharge of 8.7 feet. At maximum spillway stage, the pool would flood 180 acres. At spillway crest, elevation 1,044, the pool area would be 140 acres. One 24-inch conduit with uncontrolled drop inlet would have a capacity of 302 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit is provided for low-water releases from joint-use pool. Flood control storage of 700 acre-feet (0.98 inch of runoff) would be provided between elevations 1,044 and 1,038, with 1,090 acre-feet of joint-use storage between elevations 1,038 and 1,027 m.s.l. The minimum pool area at elevation 1,027 would be 70 acres.

(3) Effects. Flood control storage would hold the 10-year frequency flood at damsite to non-damaging stages and alleviate flood

damages in the 7 miles of Big River above Irondale Reservoir. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 100 acres with a shoreline of 3 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 11 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 450 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 500 acres, comprising 230 acres requested by the Forest Service, 20 acres for initial recreational developments, and 250 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 2 miles of new roads. Only minor relocations to power and telephone lines are required. No cemeteries are affected by the reservoir.

f. Brady Creek Reservoir (H-5A).

(1) Location. Dam located on Brady Creek 0.2 mile above its confluence with Calvey Creek at mile 5. Calvey Creek enters the Meramec River at mile 58.3. Drainage area at damsite is 3.1 square miles. Reservoir would extend 1 mile, with a surface area of 50 acres at normal pool. The nearest large town to the reservoir is Pacific, which is about 7 miles north of the damsite. St. Clair is about 11 miles west of the reservoir. Access to the reservoir area would be provided by a public road which connects to Route N. Route N connects with State Highway 30 about 6 miles to the south in the vicinity of Lonedell.

(2) Features. The earth dam would be 43 feet high, with a crest length of 980 feet at elevation 555 m.s.l. The earth spillway, 92 feet wide at elevation 549, would have a capacity of 3,345 c.f.s. at the maximum surcharge of 5.4 feet. At maximum spillway stage, the pool would flood 100 acres. At spillway crest, elevation 549, the pool area would be 80 acres. One 24-inch diameter conduit with uncontrolled drop inlet would have a capacity of 75 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit is provided for low-water releases

from joint-use pool. Flood control storage of 640 acre-feet (3.88 inches of runoff) would be provided between elevations 549 and 537, with 80 acre-feet of joint-use storage between elevations 537 and 535 m.s.l. The minimum pool area at elevation 535 would be 30 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and alleviate flood damages in the 5 miles of Calvey Creek. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 50 acres with a shoreline of 2 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 2 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 350 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 300 acres, comprising 30 acres for initial recreational developments and 270 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.3 mile of new roads and 1 new bridge. Only minor alterations to power and telephone lines are required. No cemeteries are affected by the reservoir.

g. Little Indian Creek Reservoir (H-8).

(1) Location. Dam located at mile 4.8 on Little Indian Creek, a tributary of Indian Creek which it enters 3 miles above its confluence with the Meramec River at mile 85.0. Drainage area at damsite is 17.8 square miles. Reservoir extends 1.5 miles, with a surface area of 200 acres at normal pool. The reservoir is approximately 15 miles from Sullivan and DeSoto. Access to the reservoir area would be by a public road which connects to State Highway 47 about 2 miles east of the reservoir.

(2) Features. The earth dam would be 59 feet high, with a crest length of 1,380 feet at elevation 723 m.s.l. The earth ramp spillway, 200 feet wide at elevation 717, would have a capacity of 17,200 c.f.s. at the maximum surcharge of 5.3 feet. At maximum spillway stage, the pool would flood 350 acres. At spillway crest, elevation 715,

the pool area would be 290 acres. One 24-inch diameter conduit with uncontrolled drop inlet would have a capacity of 428 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit is provided for low-water releases from joint-use pool. Flood control storage of 2,840 acre-feet (2.99 inches of runoff) would be provided between elevations 717 and 706, with 2,080 acre-feet of joint-use storage between elevations 706 and 692 m.s.l. The minimum pool area at elevation 692 would be 100 acres.

(3) Effects. Flood control storage would hold the 20-year frequency flood at damsite to non-damaging stages and alleviate flood damages in the 4.8 miles of Little Indian Creek above Virginia Mines Reservoir. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 200 acres with a shoreline of 5 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 14 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 1,130 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 850 acres, comprising 40 acres for initial recreational developments and 810 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.3 mile of new roads. Only minor relocations to power and telephone lines are required. No cemeteries are affected by the reservoir.

h. Lost Creek Reservoir (H-10A).

(1) Location. Dam located in Clark National Forest at mile 8.0 on Lost Creek, which enters Courtois Creek at mile 15. Drainage area at damsite is 4.2 square miles. Reservoir would extend 1 mile with a surface area of 50 acres at normal pool. The nearest large town to the reservoir is Potosi, which is about 10 miles east of the reservoir. Access to the reservoir area would be by a public road which connects to State Highway 8 just north of the reservoir.

(2) Features. The earth dam would be 47 feet high, with a crest length of 690 feet at elevation 1,015 m.s.l. The concrete chute spillway, 75 feet wide at elevation 1,006, would have a capacity of 3,775 c.f.s. at the maximum surcharge of 7.8 feet. At maximum spillway stage, the pool would flood 120 acres. At spillway crest, elevation 1,006, the pool area would be 90 acres. One 24-inch diameter conduit with uncontrolled drop inlet would have a capacity of 75 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit would be provided for low-water releases from joint-use pool. Flood control storage of 670 acre-feet (2.99 inches of runoff) would be provided between elevations 1,006 and 997, with 140 acre-feet of joint-use storage between elevations 997 and 994 m.s.l. The minimum pool area at elevation 994 would be 40 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and alleviate flood damages in the 8 miles of Lost Creek and 10 miles of Courtois Creek above Meramec Park Reservoir. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 50 acres with a shoreline of 2 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 3 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 340 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 290 acres, comprising 180 acres requested by the U. S. Forest Service, 10 acres for initial recreational developments, and 100 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.2 mile of new roads and 1 new bridge. Only minor alterations to power and telephone lines are required. No cemeteries are affected by the reservoir.

i. Birch Creek Reservoir (H-6).

(1) Location. Dam located at mile 2 on Birch Creek, a tributary of Bourbeuse River at mile 6.1. Drainage area at damsite is 10.4 square miles. Reservoir extends 1 mile, with a surface area

of 200 acres at normal pool. The nearest large towns to the reservoir are Union, which is about 5 miles northwest of the reservoir, and St. Clair, which is about 6 miles south of the upper end of the reservoir on U. S. Highway 66. Access to the reservoir area would be by public road which connects to U. S. Highway 66 about 0.5 mile east of the reservoir.

(2) Features. The earth dam would be 51 feet high, with a crest length of 1,090 feet at elevation 543 m.s.l. The rock spillway, 75 feet wide at elevation 536, would have a capacity of 4,400 c.f.s. at the maximum surcharge of 6.6 feet. At maximum spillway stage, the pool would flood 280 acres. At spillway crest, elevation 536, the pool area would be 200 acres. One 24-inch diameter conduit with uncontrolled drop inlet would have a capacity of 375 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit would be provided for low-water releases from joint-use pool. No flood control storage would be provided. About 2,030 acre-feet of joint-use storage would be provided between elevations 536 and 521 m.s.l. The minimum pool area at elevation 521 would be 60 acres.

(3) Effects. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 200 acres with a shoreline of 4 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 15 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 750 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 660 acres, comprising 30 acres for initial recreational developments and 630 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.1 mile of new roads. Only minor alterations to power and telephone lines are required. No cemeteries are affected by the reservoir.

j. Winsell Creek Reservoir (H-11A).

(1) Location. Dam located at mile 1.0 on Winsell Creek, a tributary of Spring Creek which it enters about 7 miles above its

confluence with the Bourbeuse River at mile 43.1. Drainage area at damsite is 10.6 square miles. Reservoir extends 1 mile, with a surface area of 100 acres at normal pool. The nearest large town to the reservoir is Sullivan, which is about 4 miles south of the head of the reservoir. Access to the reservoir area would be by a public road which connects to U. S. Highway 66 at Sullivan.

(2) Features. The earth dam would be 48 feet high, with a crest length of 760 feet at elevation 824 m.s.l. The earth spillway, 180 feet wide at elevation 818, would have a capacity of 9,400 c.f.s. at the maximum surcharge of 6 feet. At maximum spillway stage, the pool would flood 270 acres. At spillway crest, elevation 818, the pool area would be 200 acres. One 24-inch diameter conduit with uncontrolled drop inlet would have a capacity of 293 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit would be provided for low-water releases from joint-use pool. Flood control storage of 1,880 acre-feet (3.32 inches of runoff) would be provided between elevations 818 and 806, with 350 acre-feet of joint-use storage between elevations 806 and 802 m.s.l. The minimum pool area at elevation 802 would be 80 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and alleviate flood damages in the 1 mile of Winsell Creek and 5 miles of Spring Creek above the Union Reservoir. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 100 acres with a shoreline of 3 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 4 feet under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 600 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 450 acres, comprising 30 acres for initial recreational developments and 420 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.1 mile of new roads. Only minor power and telephone line alterations are required. No cemeteries are affected by the reservoir.

k. Boone Creek Reservoir (H-13A).

(1) Location. Dam located on Boone Creek 9.0 miles above its confluence with Bourbeuse River at mile 76.2. Drainage area at damsite is 21.1 square miles. Reservoir would extend 2 miles, with a surface area of 150 acres at normal pool. The nearest large towns to the reservoir are Sullivan on U. S. Highway 66, which is about 5 miles east of the damsite via Route H and Bourbon, which is about 4 miles south of the head of the reservoir on Route J.

(2) Features. The earth dam would be 54 feet high, with a crest length of 1,270 feet at elevation 818 m.s.l. The earth spillway, 250 feet wide at elevation 811, would have a capacity of 13,500 c.f.s. at the maximum surcharge of 6.8 feet. At maximum spillway stage, the pool would flood 550 acres. At spillway crest, elevation 811, the pool area would be 400 acres. One 24-inch diameter conduit with uncontrolled drop inlet would have a capacity of 493 c.f.s. for passage of within-bank flows. A 12-inch diameter conduit would be provided for low-water releases from joint-use pool. Flood control storage of 4,170 acre-feet (3.71 inches of runoff) would be provided between elevations 811 and 794, with 350 acre-feet of joint-use storage between elevations 794 and 792 m.s.l. The minimum pool area at elevation 793 would be 140 acres.

(3) Effects. Flood control storage would hold the 50-year frequency flood at damsite to non-damaging stages and alleviate flood damages in the 9 miles of Boone Creek. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 150 acres with a shoreline of 4 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 1 foot under extreme drought conditions. Construction and operation of the reservoir would afford employment opportunities to a depressed area.

(4) Land. Acquisition in fee of 1,580 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 740 acres, comprising 60 acres for initial recreational developments and 680 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.1 mile of new road. Only minor alterations to power and telephone lines are required. No graves are affected by the reservoir.

1. Dry Fork Creek Reservoir (H-31).

(1) Location. Dam located on a tributary of Dry Fork Creek 1.2 miles above its confluence with Dry Fork Creek at mile 10. Dry Fork Creek enters Bourbeuse River at mile 100.7. Drainage area at damsite is 6.2 square miles. Reservoir would extend 1.5 miles, with a surface area of 200 acres at normal pool. The nearest large town to the reservoir is Owensville, which is about 10 miles northeast. Access to the reservoir area would be provided by Route B about 3 miles from U. S. Highway 50.

(2) Features. Dam would be 45 feet high, with a crest length of 1,510 feet at elevation 895 m.s.l. The earth spillway, 135 feet wide at elevation 885, would have a capacity of 6,500 c.f.s. at the maximum surcharge of 6.4 feet. At maximum spillway stage, the pool would flood 260 acres. At spillway crest, elevation 885, the pool would be 200 acres. One 36-inch diameter conduit with uncontrolled drop inlet would have a capacity of 184 c.f.s. for passage of within bank flows. A 12-inch diameter conduit is provided for low-flow releases from joint-use pool. No flood control storage would be provided. About 1,250 acre-feet of joint-use storage would be provided between elevations 885 and 874 m.s.l. The minimum pool area at elevation 874 would be 80 acres.

(3) Effects. Low-flow augmentation would enhance downstream fish and wildlife habitat. The normal pool of 200 acres with a shoreline of 3 miles would be available for recreational use, with small drawdown in normal years and a maximum drawdown of 11 feet under extreme drought conditions.

(4) Land. Acquisition in fee of 600 acres is required under the standard policy described in PARAGRAPH 45. The Bureau of Outdoor Recreation and the National Park Service have jointly recommended additional acquisition of 320 acres, comprising 30 acres for initial recreational developments and 290 acres to be reserved for future development or held in the wild state.

(5) Relocations. The reservoir will necessitate constructing 0.7 mile of new roads and 1 new bridge. Only minor relocations to power and telephone lines are required. No cemeteries are affected by the reservoir.

49. ANGLER-USE SITES

The U. S. Fish and Wildlife Service recommended acquisition of small parcels of land, strategically located along open stream reaches between and below main stream reservoirs and tributary stream reservoirs. These areas would serve as access and stopping-off points for float fishermen and hunters. Twenty-six angler-use sites, each having an area of approximately 7 acres, would be developed to satisfy requirements for sanitary facilities, drinking water, picnicking, and overnight camping. Nine of these areas would be accessible by boat only. At road access sites, parking lots and boat launching ramps would also be provided. The locations of these sites are shown on PLATE 7, and pertinent data are contained in TABLE 28.

TABLE 28
Angler-use sites

Reservoir	Site designation	Location: Mile below damsite	Location: Name	Access
BIG RIVER SUB-BASIN				
#9 Irondale	A	8	Highway 8	Road
	B	19	Terre Bleue Creek	Boat only
	C	25	Highway E	Road
	D	42	Washington Park	Road
#2A Pine Ford	E	13	Morse Mill	Road
	F	19	Island	Boat only
	G	24	Cedar Hill	Road
	H	35	Rockford Beach	Road
	I	45	Meramec River Confluence	Boat only
MERAMEC RIVER SUB-BASIN				
#27 Salem	J	8	Wesco	Boat only
	K	16	Benton Creek	Road
	L	21	Highway 8	Road
	M	30	1000 Oaks	Boat only
	N	39	Idlewild	Road
	O	44	Highway 19	Road
#40 Virginia Mines	P	9	Cove Church	Road
	Q	11.5	Little Meramec River	Boat only
	R	23	Robertsville	Road
I-14 Huzzah Creek	S	10	Huzzah	Boat only
	T	19	Highway 8	Road
I-15A Courtois Creek	U	4	Highway 8	Road
	V	16	Doss Branch	Boat only
BOURBEUSE RIVER SUB-BASIN				
#29 Union	W	10	Beuscher Creek	Road
	X	19	Highway 50	Road
	Y	28	Highway 66	Road
	Z	34	Meramec River Confluence	Boat only

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50. LOCAL PROTECTION

a. Areas studied. As stated in PARAGRAPH 43, SECTION VII, nine areas located in the flood plain of the Meramec River between the mouth and Pacific were selected for detailed analysis as having potential for development as local protection projects. None of the areas has flood protection of any kind at the present time. It would be possible from an engineering standpoint to protect each area by means of a levee, with relatively short reaches of floodwall in two areas where space limitations preclude the use of a levee embankment. Locations of areas and levee alinements are shown on PLATE 8. Pertinent data for each project studied are shown in TABLE 29.

b. Factors affecting levee design. The study revealed certain factors common to all areas which would have a marked influence on levee location and design. These factors are as follows:

(1) Clubhouses. There are extensive clubhouse developments along the banks of the Meramec River in most areas. Insofar as possible, levees would be located landward of these developments.

(2) Riverbanks. Channel alinement of the Meramec River is generally stable. There have been no significant channel changes within the last 30 or more years within the reaches under study. Some sections of the riverbank are steep and subject to caving and must be stabilized to prevent failure of the levees.

(3) Borrow pits. Because the areas considered for protection are relatively small with extensive clubhouse developments near the riverbanks, riverside borrow is not proposed. Suitable sources of borrow material are available within reasonable haul distance in the unprotected flood plain areas and from proposed creek diversions. Other potential sources of borrow are bluff overburden and terrace lands in certain protected areas.

c. Levee design. Levees would be constructed 2 feet above the design flood. The design flood for the agricultural areas is equivalent to the 50-year flood profile, and for the urban and industrial areas, both existing and potential, is equivalent to the 200-year frequency flood profile, as modified by the reservoirs outlined herein and influenced by backwater from equivalent frequency floods on the Mississippi River, as modified by Mississippi River and tributary reservoirs upstream.

TABLE 29
Pertinent data, local protection

Name and number of area	Land protected (acres)	Selected degree of protection (frequency)	Length of levee (feet)	Average height of levee (feet)	Floodwall length (feet)	Average height of floodwall (feet)	Embankment right-of-way (acres)	Riverbank revetment (lin. ft.)	Closure structures		Bridges		Pump stations	Pump station capacity (c.f.s.)
									Highway	Railroad	Highway	Railroad		
Telegraph Road (2)	325	50-year	11,300	23	--	-	45	5,500	1	-	-	-	2	432 & 120
Starling Airport (4)	705	50-year	14,400	18	130	18	49	-	-	1	-	-	2	205 & 696
Butler Lakes (5)	1,110	50-year	31,300	14	-	-	93	16,000	-	-	-	-	2	654 & 155
Fenton (7)	70	200-year	8,300	10	1,500	4	22	-	2	-	-	-	1	411
West Watson Road (8)	380	200-year	14,500	9	-	-	32	-	-	-	1	-	1	188
Weiss Airport (9)	590	200-year	22,600	9	-	-	50	-	-	-	-	-	1	684
Valley Park (11)	500	200-year	17,400	10	-	-	46	1,000	1	1	-	-	1	211
Peerless Park (12)	900	200-year	23,700	10	-	-	62	9,000	-	-	1	1	1	474
Fox Creek (17)	745	50-year	8,000	11	-	-	14	1,500	-	-	1	-	1	624

Cedar Hill
Times Beach
Pacific

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Levee embankment is based on the standard section utilizing selected materials. The cross section consists of a 10-foot wide crown, with an 8-foot wide crushed-stone road for inspection, maintenance, and access during flood emergencies. In certain areas subject to current attack, revetment would be placed on the riverside slopes. While no unusual foundation or underseepage problems are contemplated, landside berms and pressure relief wells are provided to insure positive underseepage control where needed. Flank levees would be constructed along tributary streams. In order to minimize interior drainage problems, creeks would be diverted, where practicable, along back levees. Ditching, ponding where appropriate, gravity drainage structures, and pumping stations would be provided for removal of interior drainage.

d. Project features.

(1) Telegraph Road (area No. 2).

(a) Description of area. Area No. 2 is located along the left bank between miles 1.7 and 3.4. The area is bisected by the embankment of St. Louis County Highway VV (Telegraph Road), which crosses the Meramec River at mile 2.0. The area is flooded about twice in 3 years by the Meramec River. Except for clubhouses along the riverbank, the land is now used for agriculture. The proposed levee would protect 325 acres from the 50-year frequency flood in the Meramec River, as modified by reservoirs, and from backwater caused by a 50-year frequency flood on the Mississippi River. Probable future land use after protection would be a higher type of agricultural use, such as truck farming.

(b) Project structures. The proposed levee would have a length of 11,300 feet and an average height of 23 feet. A highway closure structure would be provided at Highway VV. Separate pumping stations with ponding areas are proposed for the two interior drainage areas created by the highway embankment, with capacities of 432 c.f.s. for the upstream area and 120 c.f.s. for the downstream area. Further study may show that a single pumping station with a culvert through the highway would be more economical. About 7,000 feet of interior ditching would be required. Approximately 5,500 linear feet of caving riverbank would need to be stabilized.

(c) Land and relocations. About 150 acres of land would be required, of which 45 acres would be for rights-of-way,

80 acres for borrow areas, and 25 acres for ditching, ponding, and relocations. Approximately 0.5 mile of existing crushed-stone road would have to be relocated to preserve access to the clubhouses. Minor alterations to local telephone and electric service lines would be required. Approximately 12 houses and clubhouses would have to be relocated.

(2) Starling Airport (area No. 4).

(a) Description of area. Area No. 4 is located along the right bank between miles 3.4 and 6.0. The St. Louis-San Francisco Railroad crosses the area. The area is flooded about once in 2 years by the Meramec River. The land is now in timber and waste-land with scattered agriculture. The river front has been developed intensively with clubhouses. Subdivisions are being developed on high ground in the southern part of the area. A public swimming pool and picnic area have recently been constructed. The proposed levee would protect 705 acres from the 50-year frequency flood in the Meramec River, as modified by reservoirs, and from backwater caused by a 50-year frequency flood on the Mississippi River. Probable future land use after protection would be residential and recreational usage.

(b) Project structures. The proposed levee would have a length of 14,400 feet and an average height of 18 feet. A floodwall about 130 feet in length and 18 feet high would be required where the levee alinement passes through the St. Louis-San Francisco Railroad trestle at the river front. A closure structure would be provided at the southern railroad crossing. Separate pumping stations with ponding areas are proposed for the two natural drainage areas, with capacities of 205 c.f.s. for the upstream area and 696 c.f.s. for the downstream area. The riverbank is stable and no revetment is required. Approximately 8,000 feet of interior ditching would be required.

(c) Land and relocations. About 124 acres of land would be required, of which 49 acres would be for rights-of-way, 45 acres for borrow areas, and 30 acres for ditching, ponding, and relocations. Approximately 1.0 mile of bituminous road would have to be relocated to maintain access to the clubhouses. Minor alterations to local telephone and electric service lines would be required. About 32 houses and clubhouses would have to be relocated.

(3) Butler Lakes (area No. 5).

(a) Description of area. Area No. 5, located along the left bank between miles 6.9 and 12.5, is flooded about once in 2 years by the Meramec River. The area is traversed by State Highway 21. Land in the area is devoted principally to agriculture. The proposed levee would protect 1,110 acres from the 50-year frequency Meramec River flood, as modified by reservoirs, and from backwater caused by a 50-year frequency flood on the Mississippi River. Probable future land use after protection would be for residential development.

(b) Project structures. The proposed levee would have a length of 31,300 feet and an average height of 14 feet. Separate pumping stations with ponding areas are proposed for the two natural drainage areas, with capacities of 654 c.f.s. for the upstream area and 155 c.f.s. for the downstream area. About 2,500 feet of creek diversion and 10,000 feet of interior ditching would be required. Approximately 16,000 feet of revetment would be required for bank stabilization.

(c) Land and relocations. About 182 acres of land would be required, of which 93 acres would be for rights-of-way, 72 acres for borrow areas, and 17 acres for ditching, ponding, and relocations. Approximately 0.4 mile of existing crushed-stone road and 0.2 mile of bituminous surfaced road would have to be relocated to preserve access to houses and clubhouses. Minor alterations to local telephone and electric service lines would be required. About 15 houses and clubhouses would be relocated.

(4) Fenton (area No. 7).

(a) Description of area. Area No. 7 is located along the right bank of the Meramec River at the town of Fenton, mile 15.0. This area is subject to flash floods from Fenton Creek and Meramec River backwater. Most of the area is urban except for an undeveloped portion south of Highway 30. The proposed levee and floodwall would protect 70 acres from a 200-year frequency Meramec River flood, as modified by reservoirs, from flash floods in Fenton Creek, and from backwater caused by a 200-year frequency flood on the Mississippi River. Probable future land use after protection would be urban and commercial or light industrial development.

(b) Project structures. The proposed levee would have a length of 8,300 feet and an average height of 10 feet. The floodwall, located within the Fenton urban complex, would have a length of 1,500 feet and an average height of 4 feet. Two highway closure structures would be required. One pumping station having a capacity of 411 c.f.s. would be required. Approximately 1,000 feet of interior ditching would be required. No bank stabilization is required.

(c) Land and relocations. About 40 acres would be required, of which 22 acres would be for rights-of-way, 16 acres for borrow areas, and 2 acres for ditching and relocations. Twenty-three houses and clubhouses and one store building would require relocation. One public swimming pool would have to be abandoned. Numerous minor alterations to electric and telephone lines would be required.

(5) West Watson Road (area No. 8).

(a) Description of area. Area No. 8 is located along the left bank between miles 15.8 and 17.0. Access to the area is provided by Highway 30. The area is flooded once in 5 years by the Meramec River. The land is now used for agriculture, with clubhouse developments along the river front. The proposed levee would protect 380 acres from a 200-year frequency Meramec River flood, as modified by reservoirs, and from backwater caused by a 200-year frequency flood on the Mississippi River. Probable future land use after protection would be commercial or light industrial.

(b) Project structures. The proposed levee would have a length of 14,500 feet and an average height of 9 feet. One pumping station having a capacity of 188 c.f.s. would be required. About 5,500 feet of creek diversion and 4,000 feet of interior ditching would be required. The riverbank is stable and no revetment is required.

(c) Land and relocations. About 57 acres would be required, of which 32 acres would be for rights-of-way, 15 acres for borrow areas, and 10 acres for ditching, ponding, and relocations. A highway bridge alteration would be required on West Watson Road, and approximately 0.6 mile of crushed-stone road would have to be relocated to preserve access to the area. Minor alterations to local electric and telephone service lines would be required. Approximately 15 houses and clubhouses would be relocated.

(6) Weiss Airport (area No. 9).

(a) Description of area. Area No. 9 is located along the right bank between miles 16.4 and 20.3. Access to the area is provided by Interstate Highway I-44 (U. S. Highways 50-66). The low-lying portions of the area which are used for farming are flooded about once every 3 years by the Meramec River. Clubhouse developments border along the riverbank. The proposed levee would protect 590 acres from the 200-year frequency flood on the Meramec River, as modified by the reservoirs, and from backwater caused by a 200-year frequency flood on the Mississippi River. Probable future land use after protection would be commercial or light industrial.

(b) Project structures. The proposed levee would have a length of 22,600 feet and an average height of 9 feet. One pumping station with ponding area is proposed, with a capacity of 684 c.f.s. About 9,000 feet of interior ditching would be necessary. The riverbank is stable and no revetment would be required.

(c) Land and relocations. About 100 acres of land would be required, of which 50 acres would be for rights-of-way, 26 acres for borrow areas, and 24 acres for ditching, ponding, and relocations. Approximately 0.5 mile of existing bituminous surfaced road would have to be relocated. Minor alterations to local electric and telephone service lines would be required. Approximately 20 houses and clubhouses would have to be relocated.

(7) Valley Park (area No. 11).

(a) Description of area. Area No. 11 is located along the left bank between miles 20.8 and 22.3. The area includes the town of Valley Park and is crossed by State Highway 141 and the Missouri Pacific and St. Louis-San Francisco Railroads. The low-lying areas are flooded once every 2 years, and portions of the town of Valley Park are flooded once every 5 years by the Meramec River. The town is also subject to flash floods by Grand Glaize Creek and Fishpot Creek. Most of this area is urban except for an undeveloped area near the river front. The proposed levee would protect 500 acres from the 200-year frequency Meramec River flood, as modified by reservoirs, and from flash floods in Grand Glaize and Fishpot Creeks. Probable future land use after protection would be urban and commercial.

(b) Project structures. The proposed levee would have a length of 17,400 feet and an average height of 10 feet. Closure structures will be provided at the State Highway 141 crossing and the St. Louis-San Francisco Railroad crossing. One pumping station with a capacity of 211 c.f.s. is proposed. Approximately 2,000 feet of interior ditching would be required. About 1,000 feet of revetment will be needed to stabilize the banks on Grand Glaize and Fishpot Creeks.

(c) Land and relocations. About 87 acres of land would be required, of which 46 acres would be for rights-of-way, 35 acres for borrow areas, and 6 acres for ditching, ponding, and relocations. Minor alterations to local telephone and electric service lines would be required, and about 23 houses and clubhouses would have to be relocated.

(8) Peerless Park (area No. 12).

(a) Description of area. Area No. 12 is located along the right bank between miles 21.3 and 24.1. Interstate Highway 44 and State Highway 141 cross the area, as well as the St. Louis-San Francisco Railroad. The area is flooded twice every 3 years by the Meramec River. The land is now used for agriculture, with clubhouse developments along the river. The proposed levee would protect 900 acres from the 200-year frequency Meramec River flood, as modified by reservoirs. Probable future land use after protection would be commercial or industrial.

(b) Project structures. The proposed levee would have a length of 23,700 feet and an average height of 10 feet. Williams Creek would be diverted along the back levee. One pumping station having a capacity of 474 c.f.s. with ponding area would be required. About 8,000 feet of interior ditching would be needed. Stabilization of the riverbank would require about 9,000 feet of revetment.

(c) Land and relocations. About 136 acres of land would be required, of which 62 acres would be for rights-of-way, 49 acres for borrow areas, and 25 acres for ditching, ponding, and relocations. Approximately 1.5 miles of crushed-stone road would have to be relocated. Diversion of Williams Creek would require construction of a new bridge at the St. Louis-San Francisco Railroad crossing and a new bridge for local access to the area. Minor alterations to local electric and telephone service lines would be required. About 18 houses and clubhouses would require relocation.

(9) Fox Creek (area No. 17).

(a) Description of area. Area No. 17 is located along the left bank between miles 45.2 and 46.5. The area is flooded once every year by the Meramec River and flash floods in Fox Creek. The land is now used for agriculture. The proposed levee plan includes diversion of Fox Creek and construction of two sections of levee to protect 745 acres from a 50-year frequency Meramec River flood, as modified by reservoirs, and from Fox Creek flash floods. Probable future land use after protection would be agricultural.

(b) Project structures. The proposed levees would have a combined length of 8,000 feet and an average height of 11 feet. One pump station with a capacity of about 624 c.f.s., with ponding area, is proposed. About 7,500 feet of creek channel excavation would be required to divert Fox Creek. About 1,500 feet of revetment would be required on Fox Creek upstream from the diversion channel.

(c) Land and relocations. About 78 acres of land would be required, of which 14 acres would be for rights-of-way, 22 acres for borrow areas, and 42 acres for ditching, ponding, and relocations. Approximately 0.9 mile of crushed-stone road would be relocated. Minor alterations to local electric and telephone service lines would be required. One new bridge over the Fox Creek diversion channel would be required to maintain access to the area.

SECTION IX - ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES

51. RESERVOIRS

a. Estimates of first costs. Estimates of first costs of reservoirs are based on the assumption by the United States of all costs of construction of the dams and appurtenant works, acquisition of lands and rights-of-way, alterations and relocations of highways, railroads, and utilities, and other remedial measures as necessary. Estimates of land costs also reflect subordination of mineral rights within the project area. Unit costs are based on July 1963 price levels and upon experience with comparable types of work within the general area. Allowances are included for contingencies and maintenance during construction. The designs and cost estimates for all main stream and tributary stream reservoirs were prepared by the St. Louis District office. The designs and cost estimates for the headwater reservoirs were prepared by the Soil Conservation Service, U. S. Department of Agriculture, and are contained in APPENDIX G. All estimates have been expanded to include the Federal Government's share of the initial recreational features. Total project construction costs are summarized in TABLES 30, 31, and 32, and are presented in detail in APPENDIX T.

b. Annual charges. Net investment costs were computed on the basis of construction costs plus interest during construction, where applicable, less the estimated salvage value of the land and minerals. A construction period of 4 years was used to determine interest during construction for the main stream reservoirs, except Meramec Park (No. 17) which has an assumed construction period of 5 years due to the extensive land acquisition and recreational development required. The construction period for tributary stream reservoirs was assumed to be over 2 years but less than 3, and for headwater reservoirs to be less than 2 years. Average annual economic costs include interest, amortization on a sinking fund basis over a 100-year economic life, annual operation and maintenance costs, charges for replacements on a sinking fund basis, and an allowance for loss of productivity on lands required for the projects. Interest and amortization were computed at 3 percent, the current average rate of interest payable by the Treasury on interest-bearing marketable securities of the United States. Average annual charges are summarized in TABLE 33 and are presented in detail in APPENDIX T.

TABLE 30
Cost summary, main stream reservoirs

Reservoir	01. Lands and damages	02. Relocations	03. Reservoirs	04. Dams	06. Fish and wildlife facilities	08. Roads, railroads, and bridges	14. Recreation facilities	19. Buildings, grounds and utilities	20. Permanent operating equipment	30. Engineering and design	31. Supervision and administration	Total project cost
Pine Ford (2A)	$ 5,960,000	$ 5,663,000	$ 312,000	$ 7,758,000	$ 10,000	$ 364,000	$ 900,000	$ 217,000	$ 176,000	$ 1,670,000	$ 1,170,000	$ 24,200,000
Washington Park (5)	1,145,000	2,593,000	138,000	9,705,000	10,000	234,000	120,000	217,000	108,000	1,420,000	1,110,000	16,800,000
Irondale (9)	1,910,000	3,570,000	219,000	4,678,000	10,000	342,000	480,000	217,000	153,000	1,130,000	791,000	13,500,000
Virginia Mines (40)	3,915,000	3,219,000	492,000	6,590,000	10,000	407,000	1,000,000	217,000	149,000	1,410,000	991,000	18,400,000
Meramec Park (17)	10,918,000	6,885,000	1,206,000	10,795,000	10,000	163,000	3,150,000	229,000	194,000	2,240,000	1,910,000	37,700,000
Salem (27)	1,300,000	2,070,000	177,000	7,871,000	10,000	313,000	460,000	217,000	157,000	1,330,000	995,000	14,900,000
Union (29)	6,577,000	4,394,000	750,000	9,395,000	10,000	341,000	750,000	217,000	176,000	1,740,000	1,250,000	25,600,000
Total for main stream reservoirs	$31,725,000	$28,394,000	$3,294,000	$56,792,000	$ 70,000	$2,164,000	$6,860,000	$1,531,000	$1,113,000	$10,940,000	$ 8,217,000	$151,100,000

TABLE 31
Cost summary, tributary stream reservoirs

Reservoir	01. Lands and damages	02. Relocations	03. Reservoirs	04. Dams	06. Fish and wildlife facilities	08. Roads, railroads, and bridges	14. Recreation facilities	19. Buildings, grounds, and utilities	20. Permanent operating equipment	30. Engineering and design	31. Supervision and administration	Total project cost
Huzzah Creek (I-14)	$ 1,130,000	$ 153,000	$ 49,000	$ 3,483,000	$ 3,000	$ 444,000	$ 50,000	$ 181,000	$ 75,000	$ 655,000	$ 417,000	$ 6,640,000
Courtois Creek (I-15A)	545,000	430,000	46,000	3,556,000	3,000	787,000	100,000	182,000	74,000	761,000	466,000	6,950,000
Peavine Creek (I-21)	265,000	256,000	32,000	1,557,000	3,000	228,000	50,000	182,000	74,000	527,000	266,000	3,440,000
Little Dry Fork Creek (I-23)	520,000	236,000	35,000	2,490,000	3,000	127,000	173,000	182,000	74,000	677,000	353,000	4,870,000
West Fork Huzzah Creek (I-26)	247,000	320,000	32,000	2,308,000	3,000	160,000	50,000	182,000	74,000	578,000	326,000	4,280,000
Spring Creek (I-28)	726,000	805,000	63,000	1,536,000	3,000	260,000	160,000	182,000	88,000	632,000	325,000	4,780,000
Terre Bleue Creek (I-30)	285,000	336,000	23,000	1,628,000	3,000	110,000	100,000	182,000	82,000	523,000	268,000	3,540,000
Redoak Creek (I-32)	814,000	346,000	60,000	1,794,000	3,000	155,000	100,000	182,000	81,000	579,000	296,000	4,410,000
Little Bourbeuse River (I-33A)	400,000	281,000	40,000	2,742,000	3,000	379,000	50,000	182,000	81,000	621,000	371,000	5,150,000
Brush Creek (I-35A)	466,000	580,000	60,000	2,593,000	3,000	168,000	50,000	182,000	81,000	651,000	366,000	5,200,000
Bourbeuse River (I-38)	725,000	279,000	89,000	2,516,000	3,000	314,000	313,000	194,000	160,000	641,000	376,000	5,610,000
Benton Creek (I-41)	167,000	513,000	16,000	1,558,000	3,000	254,000	50,000	182,000	81,000	566,000	290,000	3,680,000
Total for tributary reservoirs	$ 6,290,000	$ 4,535,000	$ 545,000	$27,761,000	$ 36,000	$3,386,000	$1,246,000	$2,195,000	$1,025,000	$ 7,411,000	$ 4,120,000	$ 58,550,000

TABLE 32
Cost summary, headwater reservoirs

Reservoir	01. Lands and damages	02. Relocations	03. Reservoirs	04. Dams	06. Fish and wildlife facilities	08. Roads, railroads, and bridges	14. Recreation facilities	19. Buildings, grounds, and utilities	20. Permanent operating equipment	30. Engineering and design	31. Supervision and administration	Total project cost
Dry Creek (H-3)	$ 161,000	$ 5,000	$ 6,000	$ 124,000	$ 3,000	$ 8,000	$ 25,000	$ 5,000	$ 7,000	$ 46,000	$ 29,000	$ 419,000
Cabanne Course (H-4)	178,000	25,000	8,000	337,000	3,000	5,000	25,000	5,000	7,000	104,000	43,000	740,000
Brady Creek (H-5A)	87,000	26,000	8,000	124,000	-	2,000	25,000	5,000	7,000	49,000	29,000	362,000
Birch Creek (H-6)	262,000	11,000	6,000	329,000	3,000	8,000	50,000	5,000	7,000	105,000	44,000	830,000
Little Indian Creek (H-8)	303,000	24,000	8,000	409,000	3,000	21,000	50,000	5,000	7,000	132,000	58,000	1,020,000
Bates Creek (H-9)	136,000	9,000	6,000	240,000	3,000	21,000	25,000	5,000	7,000	79,000	35,000	566,000
Lost Creek (H-10A)	79,000	32,000	12,000	201,000	3,000	16,000	25,000	5,000	7,000	75,000	33,000	488,000
Winsell Creek (H-11A)	190,000	7,000	4,000	79,000	3,000	4,000	25,000	5,000	7,000	34,000	21,000	379,000
Boone Creek (H-13A)	289,000	4,000	14,000	288,000	3,000	2,000	25,000	5,000	7,000	87,000	37,000	761,000
Big River (H-25)	162,000	21,000	8,000	209,000	3,000	23,000	25,000	5,000	7,000	75,000	33,000	571,000
Dry Fork Creek (H-31)	116,000	30,000	2,000	216,000	3,000	16,000	25,000	5,000	7,000	76,000	34,000	530,000
Coonville Creek (H-40)	138,000	-	8,000	203,000	-	21,000	25,000	5,000	7,000	67,000	30,000	504,000
Total for headwater reservoirs	$ 2,101,000	$ 194,000	$ 90,000	$ 2,759,000	$ 30,000	$ 147,000	$ 350,000	$ 60,000	$ 84,000	$ 929,000	$ 426,000	$ 7,170,000
Grand total for all reservoirs	$40,116,000	$33,123,000	$3,929,000	$87,312,000	$136,000	$5,697,000	$8,456,000	$3,786,000	$2,222,000	$19,280,000	$12,763,000	$216,820,000

TABLE 33
Average annual charges

Reservoir	Total project cost	Economic annual charge
Main stream reservoirs		
Pine Ford (2A)	$ 24,200,000	$ 1,200,800
Washington Park (5)	16,800,000	737,500
Irondale (9)	13,500,000	676,100
Virginia Mines (40)	18,400,000	1,051,200
Meramec Park (17)	37,700,000	1,941,800
Salem (27)	14,900,000	699,100
Union (29)	25,600,000	1,244,800
Total for main stream reservoirs	$151,100,000	$ 7,551,300
Tributary stream reservoirs		
Huzzah Creek (I-14)	$ 6,640,000	$ 312,700
Courtois Creek (I-15A)	6,950,000	320,300
Peavine Creek (I-21)	3,440,000	145,900
Little Dry Fork Creek (I-23)	4,870,000	264,500
West Fork Huzzah Creek (I-26)	4,280,000	202,300
Spring Creek (I-28)	4,780,000	259,800
Terre Bleue Creek (I-30)	3,540,000	207,200
Redoak Creek (I-32)	4,410,000	241,400
Little Bourbeuse River (I-33A)	5,150,000	245,900
Brush Creek (I-35A)	5,200,000	250,600
Bourbeuse River (I-38)	5,610,000	343,800
Benton Creek (I-41)	3,680,000	152,800
Total for tributary stream reservoirs	$ 58,550,000	$ 2,947,200
Headwater reservoirs		
Dry Creek (H-3)	$ 419,000	$ 30,600
Cabanne Course (H-4)	740,000	40,500
Brady Creek (H-5A)	362,000	26,400
Birch Creek (H-6)	830,000	49,300
Little Indian Creek (H-8)	1,020,000	55,700
Bates Creek (H-9)	566,000	30,400

TABLE 33 (Cont'd)

Reservoir	Total project cost	Economic annual charge
Lost Creek (H-10A)	$ 488,000	$ 25,800
Winsell Creek (H-11A)	379,000	31,100
Boone Creek (H-13A)	761,000	45,400
Big River (H-25)	571,000	30,500
Dry Fork Creek (H-31)	530,000	25,400
Coonville Creek (H-40)	504,000	33,000
Total for headwater reservoirs	$ 7,170,000	$ 424,100
Total for all reservoirs	$216,820,000	$10,922,600

52. LOCAL PROTECTION

a. Estimates of first costs. Estimates of first costs are based on the assumption that the Federal Government would construct the levees, drainage outlets, closure structures, pumping plants, access roads on top of levee, and railroad alterations as required. Non-Federal interests would furnish all lands, easements, and right-of-way, bear all property damage costs, provide the necessary interior drainage ditches, except the main ditches at the pumping plants, and bear all costs for relocations of roads and utilities. Unit costs are based on July 1963 price levels and upon experience with comparable types of work within the general area. The designs and cost estimates which include allowances for contingencies were prepared by the St. Louis District office. Total project construction costs are summarized in TABLE 34 and are presented in detail in APPENDIX T.

b. Annual charges. Economic first costs were computed on the basis of construction costs alone. A construction period of less than 2 years was assumed for all of the levees under consideration; hence charges for interest during construction were not included in the economic first costs. Average annual economic costs include interest, amortization on a sinking fund basis over the applicable economic life, annual operation and maintenance costs, charges for replacements on a sinking fund basis, and an allowance for loss of productivity on lands required for the projects. Interest and amortization were computed at 3 percent, the current average rate of interest.

TABLE 34
Cost summary, local protection projects

	Levee area	01. Lands and damages	02. Relocations	11. Levees and floodwalls	13. Pumping plants	30. Engineering and design	31. Supervision and administration	Total
2	Telegraph Road							
	Federal costs	$ -	$ -	$ 980,000	$ 900,000	$ 240,000	$ 160,000	$ 2,280,000
	Non-Federal costs	200,000	19,000	11,000	-	4,000	3,000	237,000
	Total project costs	200,000	19,000	991,000	900,000	244,000	163,000	2,517,000
4	Starling Airport							
	Federal costs	-	-	699,000	1,239,000	248,000	164,000	2,350,000
	Non-Federal costs	265,000	86,000	7,000	-	12,000	8,000	378,000
	Total project costs	265,000	86,000	706,000	1,239,000	260,000	172,000	2,728,000
5	Butler Lakes							
	Federal costs	-	-	1,528,000	1,142,000	339,000	221,000	3,230,000
	Non-Federal costs	286,000	34,000	10,000	-	5,000	4,000	339,000
	Total project costs	286,000	34,000	1,538,000	1,142,000	344,000	225,000	3,569,000
7	Fenton							
	Federal costs	-	-	402,000	602,000	128,000	88,000	1,220,000
	Non-Federal costs	674,000	-	-	-	-	-	674,000
	Total project costs	674,000	-	402,000	602,000	128,000	88,000	1,894,000
8	West Watson Road							
	Federal costs	-	-	203,000	373,000	73,000	49,000	698,000
	Non-Federal costs	108,000	68,000	2,000	-	9,000	6,000	193,000
	Total project costs	108,000	68,000	205,000	373,000	82,000	55,000	891,000
9	Weiss Airport							
	Federal costs	-	-	337,000	844,000	151,000	98,000	1,430,000
	Non-Federal costs	165,000	41,000	4,000	-	6,000	4,000	220,000
	Total project costs	165,000	41,000	341,000	844,000	157,000	102,000	1,650,000
11	Valley Park							
	Federal costs	-	-	723,000	393,000	141,000	93,000	1,350,000
	Non-Federal costs	282,000	-	4,000	-	1,000	2,000	289,000
	Total project costs	282,000	-	727,000	393,000	142,000	95,000	1,639,000

TABLE 34 (Cont'd)

	Levee area	01. Lands and damages	02. Relocations	11. Levees and floodwalls	13. Pumping plants	30. Engineering and design	31. Supervision and administration	Total
12	Peerless Park							
	Federal costs	$ -	$ 284,000	$ 741,000	$ 559,000	$ 200,000	$ 126,000	$ 1,910,000
	Non-Federal costs	201,000	143,000	4,000	-	23,000	12,000	383,000
	Total project costs	201,000	427,000	745,000	559,000	223,000	138,000	2,293,000
17	Fox Creek							
	Federal costs	-	-	289,000	781,000	137,000	93,000	1,300,000
	Non-Federal costs	46,000	129,000	5,000	-	17,000	10,000	207,000
	Total project costs	46,000	129,000	294,000	781,000	154,000	103,000	1,507,000
	Total, local protection projects	$2,227,000	$ 804,000	$5,949,000	$6,833,000	$1,734,000	$1,141,000	$18,688,000
	Federal costs	$ -	$ 284,000	$5,902,000	$6,833,000	$1,657,000	$1,092,000	$15,768,000
	Non-Federal costs	$2,227,000	$ 520,000	$ 47,000	$ -	$ 77,000	$ 49,000	$ 2,920,000

The economic life was based on the degree of flood protection provided. For those areas with levees designed to provide protection against floods having a frequency of occurrence of once in 50 years, an economic life of 50 years was used. For the remaining levee areas designed to provide protection to potential urban and industrial areas against a flood having a frequency of occurrence of once in 200 years, an economic life of 100 years was used. Average annual charges based on economic costs are summarized in TABLE 35 and are presented in detail in APPENDIX T.

53. ANGLER-USE SITES

a. Estimates of first costs. Estimates of first costs are based on the assumption by the Federal Government of all construction costs of the required developments and acquisition of lands and rights-of-way. The angler-use sites were divided into two broad categories: those sites having access both by road and water; and those accessible by water only. The type and scale of development were based on criteria furnished by the U. S. Fish and Wildlife Service, Department of the Interior. All sites would provide sanitary facilities, drinking water, and picnic and camping facilities. In addition to these basic facilities, a parking lot, boat launching ramp, and access road would also be provided in the road access sites. Unit costs are based on July 1963 price levels and upon experience with comparable types of work within the general area. The design and cost estimates which include contingency allowances were prepared by the St. Louis District office. Total project costs are summarized in TABLE 36 and are presented in detail in APPENDIX T.

b. Annual charges. Economic first costs were computed on the basis of construction costs alone. A construction period of less than 2 years was assumed for all of the angler-use sites; hence, charges for interest during construction were not included in the economic first costs. Average annual economic costs include interest, amortization on a sinking fund basis over a 50-year economic life, annual operation and maintenance costs, charges for replacements on a sinking fund basis, and an allowance for loss of productivity. Interest and amortization were computed at 3 percent, the current average rate of interest. All operation, maintenance, and replacement costs are non-Federal responsibility. Average annual charges based on the economic costs are summarized in TABLE 37 and are presented in detail in APPENDIX T.

TABLE 35
Average annual charges, local protection

Levee area	Degree of protection provided	Economic life	Project costs			Economic annual charges		
			Federal	Non-Federal	Total	Federal	Non-Federal	Total
No. 2 Telegraph Road	50-year	50-year	$ 2,280,000	$ 237,000	$ 2,517,000	$ 88,600	$ 34,300	$122,900
No. 4 Starling Airport	50-year	50-year	2,350,000	378,000	2,728,000	91,300	36,400	127,700
No. 5 Butler Lakes	50-year	50-year	3,230,000	339,000	3,569,000	125,600	62,000	187,600
No. 7 Fenton	200-year	100-year	1,220,000	674,000	1,894,000	38,600	32,500	71,100
No. 8 West Watson Road	200-year	100-year	698,000	193,000	891,000	22,100	12,900	35,000
No. 9 Weiss Airport	200-year	100-year	1,430,000	220,000	1,650,000	45,300	24,400	69,700
No. 11 Valley Park	200-year	100-year	1,350,000	289,000	1,639,000	42,700	23,200	65,900
No. 12 Peerless Park	200-year	100-year	1,910,000	383,000	2,293,000	60,500	44,000	104,500
No. 17 Fox Creek	50-year	50-year	1,300,000	207,000	1,507,000	50,500	22,700	73,200
Total, local protection projects			$15,768,000	$2,920,000	$18,688,000	$565,200	$292,400	$857,600

TABLE 36
Cost summary, angler-use sites

Controlling reservoir	Type access	Number and site designation	01. Lands and damages	14. Recreation facilities	30. Engineering and design	31. Supervision and administration	Project costs	Total cost of projects below reservoir
BIG RIVER SUB-BASIN								
Irondale (9)	Road	3 - A, C, D	$ 6,000	$ 84,000	$ 8,000	$ 2,000	$100,000	
	Boat	1 - B	2,000	13,000	1,000	1,000	17,000	$117,000
Pine Ford (2A)	Road	3 - F, G, H	6,000	84,000	8,000	2,000	100,000	
	Boat	2 - E, I	4,000	26,000	3,000	1,000	34,000	134,000
MERAMEC SUB-BASIN								
Salem (27)	Road	2 - K, L	4,000	56,000	6,000	1,000	67,000	
	Boat	1 - J	2,000	13,000	1,000	1,000	17,000	84,000
I-28 and/or Salem (27) (below Maramec Spring)	Road	2 - N, O	4,000	56,000	6,000	1,000	67,000	
	Boat	1 - M	2,000	13,000	1,000	1,000	17,000	84,000
Meramec Park (17)	Road	2 - P, R	4,000	56,000	6,000	1,000	67,000	
	Boat	1 - Q	2,000	13,000	1,000	1,000	17,000	84,000
I-26	Road	1 - T	2,000	28,000	3,000	500	33,500	
	Boat	1 - S	2,000	13,000	1,000	500	16,500	50,000
I-15A	Road	1 - U	2,000	28,000	3,000	500	33,500	
	Boat	1 - V	2,000	13,000	1,000	500	16,500	50,000

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TABLE 36 (Cont'd)

Controlling reservoir	Type access	Number and site designation	01. Lands and damages	14. Recreation facilities	30. Engineering and design	31. Supervision and administration	Project costs	Total cost of projects below reservoir
BOURBEUSE RIVER SUB-BASIN								
Union (29)	Road	3 - W, X, Y	$ 6,000	$ 84,000	$ 8,000	$ 2,000	$100,000	
	Boat	1 - Z	2,000	13,000	1,000	1,000	17,000	$117,000
Total project costs			$52,000	$593,000	$58,000	$17,000	$720,000	$720,000

TABLE 37

Angler-use sites, project costs and annual charges

Controlling reservoir	Site designation	Type of access	Name	Project** first costs	Economic annual charges** Federal	Non-Federal	Total
BIG RIVER SUB-BASIN							
Irondale (9)	A	*	Highway 8				
	B	Boat only	Terre Bleue Creek				
	C	*	Highway E				
	D	*	Washington Park	$117,000	$ 4,500	$16,300	$ 20,800
Pine Ford (2A)	E	Boat only	Morse Mill				
	F	*	Island				
	G	*	Cedar Hill				
	H	*	Rockford Beach				
	I	Boat only	Meramec River confluence	134,000	5,200	19,500	24,700
MERAMEC RIVER SUB-BASIN							
Salem (27)	J	Boat only	Wesco				
	K	*	Benton Creek				
	L	*	Highway 8	84,000	3,300	8,500	11,800
I-28 and/or Salem (27) (below Maramec Spring)	M	Boat only	1,000 Oaks				
	N	*	Idlewild				
	O	*	Highway 19	84,000	3,300	8,600	11,900
Meramec Park (17)	P	*	Cove Church				
	Q	Boat only	Little Meramec River				
	R	*	Robertsville	84,000	3,300	13,000	16,300

TABLE 37 (Cont'd)

Controlling reservoir	Site designation	Type of access	Name	Project** first costs	Economic annual charges** Federal	Non-Federal	Total
I-2b and/or I-14	S	Boat only	Huzzah				
	T	*	Highway 8	$ 50,000	$ 1,900	$ 5,300	$ 7,200
I-15A	U	*	Highway 8				
	V	Boat only	Doss Branch	50,000	1,900	5,500	7,400
BOURBEUSE RIVER SUB-BASIN							
Union (29)	W	*	Beuscher Creek				
	X	*	Highway 50				
	Y	*	Highway 66				
	Z	Boat only	Meramec River confluence	117,000	4,500	16,500	21,000
Total				$720,000	$27,900	$93,200	$121,100

*Road and boat access.

**All angler-use sites below a reservoir analyzed as a total combined system. Total project first cost would be Federal; operation and maintenance costs, including replacement, would be a non-Federal expense.

SECTION X - ESTIMATES OF BENEFITS

54. BASES FOR EVALUATION

a. General. Principal benefits attributable to the basin plan include reduction of flood damages in the Meramec River flood plain, reduction of flood crests in the Mississippi River, municipal and industrial water supply, low-flow augmentation in the interest of water quality control, general recreation, fish and wildlife conservation, and improvement in the basin economy associated with construction and operation of the reservoirs. An analysis was made of the basin's growth and needs for a 100-year period, with 1970 as the base year. Benefits expected to accrue at varying rates in the future were discounted to the base year and distributed as an equivalent uniform annual value over the period of economic analysis. The interest rate used is 3 percent. Details of benefit evaluation are contained in APPENDIX R.

b. Flood control. Benefits creditable to the reservoirs include the difference between those flood damages that are expected to occur in the absence of the reservoirs and those flood damages that are expected even if the reservoirs are constructed, plus increased utilization benefits that will result because of the reservoirs. Estimates of prospective benefits were discounted to reflect time lag in attainment. Flood damages prevented by the reservoirs are estimated at $1,413,400 annually and increased returns and changed land use benefits are estimated at $455,900 annually, for a total of $1,869,300. In addition to reducing floods in the Meramec Basin, reservoirs would effect reduction in magnitude of Mississippi River floods. Benefits attributable to the reservoirs for reduction in Mississippi River flood crests amount to $517,800 annually, and reflect those credited to the Meramec Basin in the "Mississippi River Reservoir Benefit Study". Total average annual flood control benefits creditable to reservoirs are estimated at $2,387,100. Average annual flood control benefits attributable to reservoirs are shown by sub-basins in TABLE 38. Levees were credited with the elimination of residual damages, with the reservoirs in operation, and a higher type of land use made possible by protection. Estimates of prospective benefits credited to the levees were discounted to reflect time lag in attainment. Average annual flood damages prevented are estimated at $56,800 and increased value of lands at $1,794,200, or a total of $1,851,000 annually. Detailed analyses of flood control benefits are contained in APPENDIX Q.

TABLE 38
Summation of annual flood control benefits
Reservoirs

Meramec River - main stem		
Below Big River	$447,900	
Big River to Bourbeuse River	231,600	
Above Bourbeuse River	192,700	
Meramec River tributaries	210,900	
Total Meramec River and tributaries		$1,083,100
Big River	$408,300	
Big River tributaries	71,700	
Total Big River and tributaries		$ 480,000
Bourbeuse River	$215,100	
Bourbeuse River tributaries	91,100	
Total Bourbeuse River and tributaries		$ 306,200
Total Mississippi River		$ 517,800
Total reservoir benefits		$2,387,100

c. Water supply. The Public Health Service, in its evaluation of future municipal and industrial water supply requirements, determined that during the study period, a need for supplemental water supply would occur only in the lower basin area. The value of water that could be supplied by the reservoirs was based on the least costly alternative of securing the equivalent supplemental supply by pumping from the Missouri River to the service area under consideration. The annual cost of meeting future needs, using increments of development, which a prudent user would be likely to adopt are shown in the following table. See APPENDICES L and R.

TABLE 39

Alternate cost of future water supply as a measure of benefits

Year of first need	Demand (c.f.s.)	Cost of alternate supply		
		First cost	Annual O & M and replacements	Total annual cost
1995	75	$ 4,330,000	$ 440,000	$ 763,000
2020	150	7,200,000	1,320,000	1,857,000
2045	300	30,500,000	4,356,000	6,630,000
Total	525	$42,030,000	$6,116,000	$9,250,000

Costs of alternative developments were based on a non-Federal financing rate of 5 1/2 percent for 25 years. Benefits based thereon reflect projections for the period of project analysis converted to a uniform annual series by compound interest method, using the Federal rate of 3 percent. Average annual benefits are estimated at $1,085,700.

d. Water quality control. Evaluation of water quality benefits includes consideration of low-flow augmentation in the downstream reaches and ponding effects of the reservoirs in reducing the low-flow requirements. The Public Health Service, in its evaluation, determined flow requirements for all reaches of main stem and principal tributaries in the three sub-basins under future conditions with and without reservoirs in operation. Flow requirements for future conditions with reservoirs in place, less the base flow, represent the needs to be supplied by reservoirs. The value of these needs were based on the cost of a single-purpose reservoir constructed at the same site of the reservoir used by the Public Health Service in its routings for stream flow requirements. The annual costs of meeting future needs, using increments of development, were estimated at $3,756,400. Costs were based on Federal financing rate of 3 percent. Benefits based thereon reflect projections for the period of project analysis converted to a uniform annual series by compound interest method, using the Federal rate of 3 percent. Average annual benefits amounting to $2,342,300 are shown in TABLE 40. Comparison of the flow requirements for future conditions, with and without reservoirs in place, indicated a reduction in needs for certain reaches of streams. This decrease reflects a ponding effect in reservoirs and is similar to the function that a lagoon serves in providing a tertiary degree of waste treatment. The value of this benefit has been determined as equal to the difference in cost of a single-purpose reservoir providing the required future flows with and without the reservoirs

in place. The annual costs of this reduction in future needs, using increments of development, were estimated at $561,200. Costs were based on the Federal financing rate of 3 percent. Annual benefits based thereon, properly discounted at the same rate of interest, are estimated at $71,000 and are shown in TABLE 41. Based on the foregoing, total water quality control benefits creditable to reservoirs are estimated to be $2,413,300, of which $2,342,300 is for low-flow augmentation and $71,000 is for ponding.

TABLE 40

Alternate cost of low-flow augmentation for water quality control as a measure of benefits

Sub-basin system and reach	Single-purpose reservoir	Alternate total annual cost	Discounted benefits
BIG RIVER			
BG-1	9	$ 363,300	$ 283,800
M-7	2A	658,700	464,200
MERAMEC RIVER			
M-2	I-28	139,400	110,400
M-3	27	345,200	41,100
M-7	17	1,301,600	570,100
BOURBEUSE RIVER			
B-1	I-38	161,700	143,100
B-2	I-35A, I-33A	201,700	159,500
B-3	I-35A	142,400	142,400
B-4	29	442,400	427,700
Total		$3,756,400	$2,342,300

TABLE 41
Annual cost of ponding for water quality control
as a measure of benefits

Sub-basin system and reach	Single-purpose reservoir	Alternate total annual cost	Discounted benefits
BIG RIVER			
BG-2	5	$ 76,100	$14,100
MERAMEC RIVER			
M-1	I-28	94,400	19,400
M-4	I-15A	111,000	6,700
BOURBEUSE RIVER			
B-1	I-35A	40,600	2,900
B-2	I-32	176,300	23,700
B-3	29	24,500	1,900
B-4	29	38,300	2,300
Total		$561,200	$71,000

e. Recreation. General recreation benefits were treated separately in this study and do not include the recreational aspects of fish and wildlife. Visitor-day attendance for general recreation is related to demands generated by the population within the zone of influence as of 1970, with the assumption that all 31 reservoirs would be in operation at that time. Annual attendance at these reservoirs was estimated by the Bureau of Outdoor Recreation and the National Park Service at 11,398,000 visitor-days, with an estimated benefit value of $18,209,000. For the purposes of this report, only the visitor-day attendance which would be attracted to the reservoirs based on facilities planned and operated by the Corps of Engineers was used in the benefit evaluation and is estimated at 4,300,000 visitor-days annually. Monetary values used ranged from $1.50 to $1.60 per visitor-day. Total average annual benefits are estimated at $6,860,600, and are detailed in APPENDIX R. Benefits were not discounted since it was assumed that initial facilities provided would be used to capacity over the entire project life.

f. Fish and wildlife. Hunterman- and fisherman-day attendance at the 31 reservoirs was furnished by the U. S. Fish and Wildlife Service. Based on the year 1970, increased hunterman- and fisherman-days were estimated at 1,680,000 with benefits of $2,154,700. These estimates were used by the Corps of Engineers in this report. Benefits to the angler-use sites were also determined by the U. S. Fish and Wildlife Service based on estimates of visitor-day attendance and value of utilization. Sites having boat access only would support a daily capacity of about 75 visitors with average annual use estimated at 3,600 visitor-days. Sites having access by road and boat would support a daily capacity of about 120 visitors with average annual use estimated at 6,000 visitor-days. Total annual benefits creditable to the 26 angler-use sites are estimated at $251,700. Details are contained in APPENDIX R.

g. Area reorientation. Area reorientation benefits that would accrue to the reservoirs were divided into two general categories. The first category is applicable only to those reservoirs located in counties designated as eligible for assistance under the Area Redevelopment Act, and includes benefits that would be derived from local employment during construction of the dams and facilities and subsequently for operation and maintenance of the reservoirs. The value of these benefits was determined by the savings in unemployment compensation. Total value of the wage component paid to local labor during construction was estimated at $20,265,000. Benefits based thereon are estimated at $641,600 annually for the construction period. The value of the labor costs for operation and maintenance was estimated at $4,363,400. These costs were modified to reflect decreasing values over a 10-year period of economic recovery and equated to an average annual basis. Benefits are estimated at $135,300 annually. The second category of benefits is the new job opportunities that would be created by the improved economic conditions in the upper basin resulting from the reservoirs. The value of these benefits reflects the wages that would accrue to the local economy from the money spent by the recreationists and the value of new recreation businesses, as in terms of new jobs and special services. The total annual value of the local economic development is estimated at $4,201,400, of which $2,214,200 is for wages and $1,987,200 is for economic impact. Based on the foregoing, total average annual area reorientation benefits are estimated at $4,978,300. Derivation of benefits is contained in APPENDIX R.

h. Navigation benefits. Operation of the reservoirs for low-flow augmentation in the interests of water supply, water quality control, and improved stream fisheries will provide incidental benefits to

navigation during low-flow periods on the Mississippi River. Routings of reservoir withdrawals indicate that releases will augment low-flow deficiencies in the Mississippi River and by 2045 provide benefits equal to those credited to the Meramec Basin in the report on "Mississippi River Reservoir Benefit Study". The current value of the benefits, discounted for delay in realization, is estimated at $146,000 annually. See APPENDIX R for details.

i. Negative benefits. Detrimental or negative benefits to overland transportation resulting from costs of providing greater clearances for bridges to be modified or constructed as part of the project and increased operation costs of future vehicle operation have been evaluated based upon criteria developed by the Bureau of Public Roads. Since one of the criteria used in reservoir selection was that impoundments should present no major relocation problem, the negative benefits are minor in nature. These increased costs, estimated at $25,900 annually, were deducted to obtain the net benefits for each of the reservoirs. See APPENDIX R.

55. TOTAL BASIN BENEFITS

Total average annual benefits creditable to the basin plan are estimated at $22,026,400 and are summarized in the following table.

TABLE 42
Summary of benefits

Flood control		
Mississippi River	$ 517,800	
Meramec River	1,869,300	
		$ 2,387,100
Water supply		1,085,700
Water quality		
Low flow	2,342,300	
Ponding	71,000	
		2,413,300
Recreation		
General	6,860,600	
Fish and wildlife	2,154,700	
		9,015,300
Area reorientation		4,978,300
Navigation		146,000
Subtotal, gross reservoir benefits		$20,025,700
Negative benefits		- 25,900
Subtotal, net reservoir benefits		$19,999,800

TABLE 42 (Cont'd)

Flood control	
Local protection	$ 1,851,000
Subtotal benefits	$21,850,800
Angler-use	251,700
Total basin benefits	$22,102,500

56. ALLOCATION OF BENEFITS

a. Method of allocation. Allocation of benefits to individual reservoirs is based on the reservoir's capability to meet the basin needs for each of the purposes served. Where more than one reservoir contributes to flood reduction, benefits were allocated to each reservoir in proportion to its capability in affecting reductions when acting alone. Mississippi River flood control benefits previously allocated to the Meramec Basin were redistributed to the main stream reservoirs on the basis of drainage area controlled and flood control storage provided. Water supply and water quality control benefits were determined for each of the three sub-basin areas and prorated to main stream and tributary stream reservoirs based on their contribution to flow requirements. Reservoirs were also credited with benefits attributable to improvement of stream fishery through low-flow augmentation. Stream flow regulation in the lower basin would provide incidental benefits for low-flow augmentation in the Mississippi River in the interest of navigation. These benefits were prorated to the main stream reservoirs on the basis of their contribution to downstream needs. Recreation benefits, including the recreational aspects of fish and wildlife, were assigned direct to individual reservoirs on the basis of usage. Angler-use sites were considered as groups affected by improved low flow from controlling reservoirs and benefits were assigned to each group on the basis of usage. Benefits attributable to area reorientation were assigned directly to individual reservoirs as appropriate. Negative benefits were assigned to individual reservoirs where pertinent. Benefits for local protection were credited to individual levee areas based on damages which they would prevent over and above those eliminated by and credited to reservoirs, and increased values of land which would result from protection. Details of benefit allocations are contained in APPENDIX R.

b. Summary of benefits assigned. There are shown in the following tables benefits creditable to each of the components in the basin plan.

TABLE 43
Summation of benefits - main stream reservoirs

Reservoirs	Flood Control			Water quality	Water supply	Recreation			Area reorientation	Navigation	Subtotal	Negative benefits	Total net benefits
	Total	Mississippi	Meramec			Total	General	Fishing & hunting					
Pine Ford (2A)	$ 551,700	$ 91,200	$ 460,500	$ 120,100	$ 29,500	$1,110,900	$ 912,000	$ 198,900	$ 557,100	$ 10,700	$ 2,380,000	$ 5,900	$ 2,374,100
Washington Park (5)	-	-	-	193,900	44,200	287,900	192,000	95,900	217,000	16,100	759,100	300	758,800
Irondale (9)	60,900	-	60,900	448,100	40,400	500,700	377,600	123,100	309,900	14,800	1,374,800	800	1,374,000
Virginia Mines (40)	-	-	-	20,300	-	1,650,600	1,280,000	370,600	890,700	-	2,561,600	2,400	2,559,200
Meramec Park (17)	785,700	284,200	501,500	546,400	143,300	2,197,100	1,446,600	750,500	957,000	57,100	4,686,600	8,300	4,678,300
Salem (27)	74,100	-	74,100	44,500	17,200	418,400	320,000	98,400	284,700	-	838,900	-	838,900
Union (29)	450,700	142,400	308,300	431,900	692,900	975,200	720,000	255,200	567,200	47,300	3,165,200	5,800	3,159,400
Total benefits, main stream reservoirs	$1,923,100	$517,800	$1,405,300	$1,805,200	$967,500	$7,140,800	$5,248,200	$1,892,600	$3,783,600	$146,000	$15,766,200	$23,500	$15,742,700

I-33 53,000
1,419,500

TABLE 44
Summation of benefits - tributary stream reservoirs

Reservoirs	Flood control*	Water quality	Water supply	Recreation			Area reorientation	Subtotal	Negative benefits	Total net benefits
				Total	General	Fishing & hunting				
Huzzah Creek (I-14)	$ 41,500	$ -	$ 13,300	$ 99,600	$ 69,100	$ 30,500	$ 42,100	$ 196,500	$ -	$ 196,500
Courtois Creek (I-15A)	29,900	6,700	14,600	127,100	89,600	37,500	95,200	273,500	-	273,500
Peavine Creek (I-21)	48,900	-	4,000	28,500	21,600	6,900	14,000	95,400	-	95,400
Little Dry Fork Creek (I-23)	-	70,200	6,700	189,900	176,000	13,900	107,600	374,400	700	373,700
West Fork Huzzah Creek (I-26)	4,600	-	6,600	99,300	78,100	21,200	73,100	183,600	-	183,600
I-26 (re-analysis w/I-14 out)	(46,500)	-	(6,600)	(99,300)	(78,100)	(21,200)	(73,100)	(225,500)	-	(225,500)
Spring Creek (I-28)	70,300	59,600	14,600	142,500	128,000	14,500	106,000	393,000	-	393,000
I-28 (re-analysis w/I-23 out)	(70,300)	(129,800)	(14,600)	(142,500)	(128,000)	(14,500)	(106,000)	(463,200)	-	(463,200)
Terre Bleue Creek (I-30)	30,500	-	-	135,800	128,000	7,800	101,800	268,100	100	268,000
Redoak Creek (I-32)	-	27,300	13,300	125,100	107,500	17,600	85,200	250,900	100	250,800
Little Bourbeuse River (I-33A)	-	155,900	14,600	82,300	63,000	19,300	71,700	324,500	100	324,400
I-33A (re-analysis w/I-32 out)	-	(155,900)	(18,600)	(82,300)	(63,000)	(19,300)	(71,700)	(328,500)	(100)	(328,400)
Brush Creek (I-35A)	-	145,300	10,600	65,800	52,500	13,300	34,100	255,800	1,200	254,600
I-35A (re-analysis w/I-32 out)	-	(148,900)	(13,300)	(65,800)	(52,500)	(13,300)	(34,100)	(262,100)	(1,200)	(260,900)
Bourbeuse River (I-38)	83,600	143,100	15,900	225,500	200,000	25,500	122,200	590,300	100	590,200
Benton Creek (I-41)	3,700	-	4,000	19,300	12,000	7,300	7,900	34,900	100	34,800
Total benefits (excludes 4 re-analyses)	$313,000	$608,100	$118,200	$1,340,700	$1,125,400	$215,300	$860,900	$3,240,900	$2,400	$3,238,500

*Local, Meramec River Basin benefits only.

NOTE: The above tabulation includes possible alternates for I-14, I-23, and I-32 to be analyzed for economic justification.

TABLE 45
Summation of benefits - headwater reservoirs

Reservoirs	Flood control*	Recreation			Area reorientation	Total benefits
		Total	General	Fishing & hunting		
Dry Creek (H-3)	$ 26,600	$ 41,900	$ 36,800	$ 5,100	$ 23,900	$ 92,400
Cabanne Course (H-4)	-	31,400	28,800	2,600	21,400	52,800
Brady Creek (H-5A)	16,200	23,100	21,000	2,100	16,100	55,400
Birch Creek (H-6)	-	99,800	93,600	6,200	61,000	160,800
Little Indian Creek (H-8)	22,100	92,100	86,400	5,700	57,300	171,500
Bates Creek (H-9)	14,600	24,400	21,600	2,800	16,000	55,000
Lost Creek (H-10A)	26,300	8,100	5,400	2,700	6,200	40,600
Windsell Creek (H-11A)	17,500	60,900	57,000	3,900	39,200	117,600
Boone Creek (H-13A)	24,700	78,700	72,000	6,700	47,500	150,900
Big River (H-25)	3,000	18,400	14,400	4,000	11,500	32,900
Dry Fork Creek (H-31)	-	7,900	6,000	1,900	3,900	11,800
Coonville Creek (H-40)	-	47,100	44,000	3,100	29,800	76,900
Total benefits, headwater reservoirs	$151,000	$533,800	$487,000	$46,800	$333,800	$1,018,600

*Local, Meramec River Basin benefits only.

TABLE 46
Angler-use sites, project benefits

Controlling reservoir	Site designation	Name	Project benefits*
BIG RIVER SUB-BASIN			
Irondale (9)	A	Highway 8	
	B	Terre Bleue Creek	
	C	Highway E	
	D	Washington Park	$ 36,400
Pine Ford (2A)	E	Morse Mill	
	F	Island	
	G	Cedar Hill	
	H	Rockford Beach	
	I	Meramec River confluence	47,500
MERAMEC RIVER SUB-BASIN			
Salem (27)	J	Wesco	
	K	Benton Creek	
	L	Highway 8	22,500
I-28 and/or Salem (27) (below Maramec Spring)	M	1,000 Oaks	
	N	Idlewild	
	O	Highway 19	22,500

TABLE 46 (Cont'd)

Controlling reservoir	Site designation	Name	Project benefits*
Meramec Park (17)	P	Cove Church	
	Q	Little Meramec River	
	R	Robertsville	$ 54,000
I-26	S	Huzzah	
	T	Highway 8	16,200
I-15A	U	Highway 8	
	V	Doss Branch	15,400
BOURBEUSE RIVER SUB-BASIN			
Union (29)	W	Beuscher Creek	
	X	Highway 50	
	Y	Highway 66	
	Z	Meramec River confluence	37,200
Total benefits, angler-use sites			$251,700

*All above angler-use sites below a reservoir analyzed as a total combined system.

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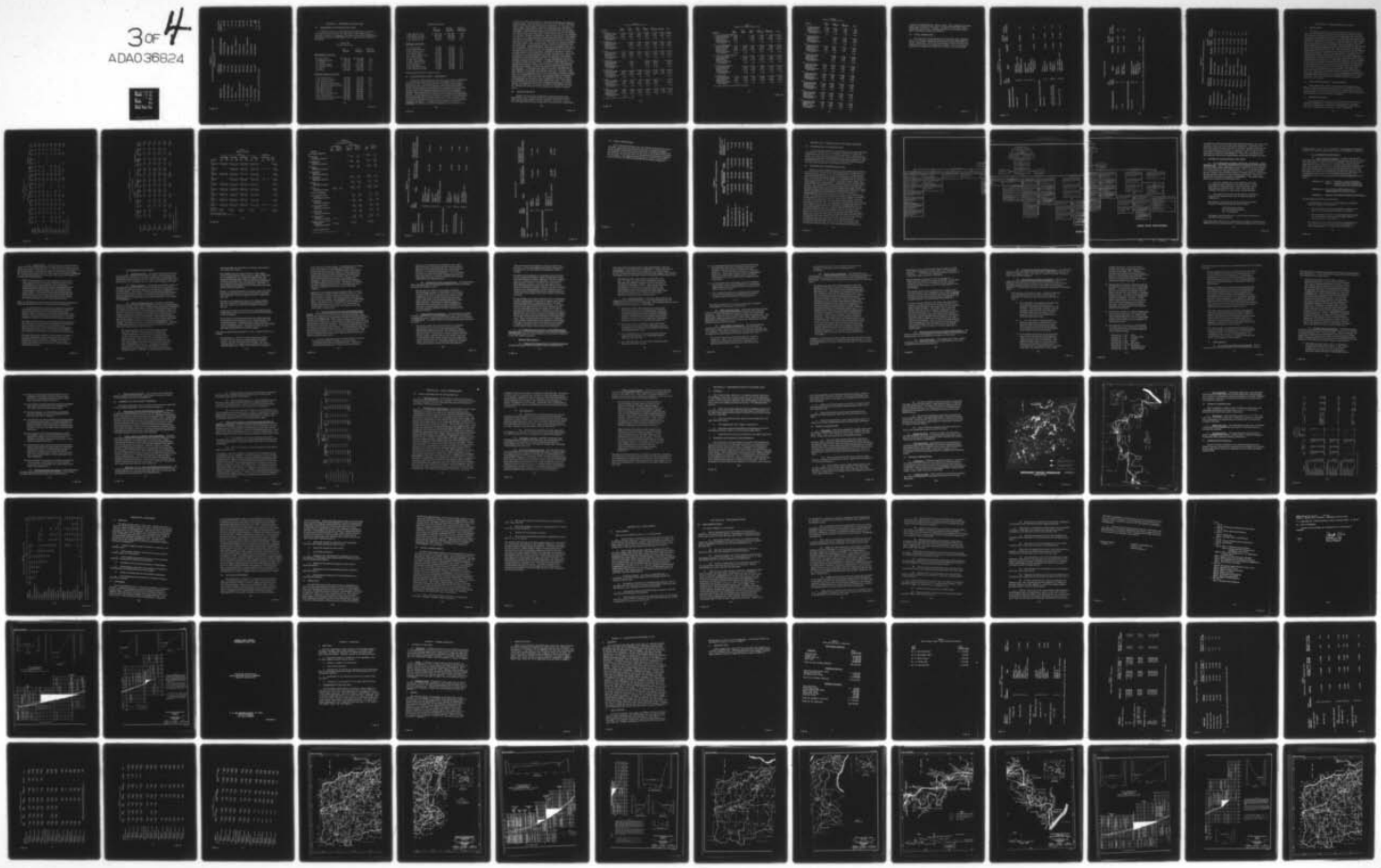

TABLE 47
Local protection projects, average annual benefits, lower basin area

	Levee area	Degree of protection	Anticipated land use	Total annual benefits
2	Telegraph Road	50-year	Truck farming	$ 20,000
4	Starling Airport	50-year	Residential	136,100
5	Butler Lakes	50-year	Residential	217,100
7	Fenton	200-year	Urban - commercial	45,500
8	West Watson Road	200-year	Commercial	350,200
9	Weiss Airport	200-year	Commercial	384,100
11	Valley Park	200-year	Urban - commercial	70,100
12	Peerless Park	200-year	Commercial	627,300
17	Fox Creek	50-year	Agricultural	600
Total benefits, local protection levees.				$1,851,000

SECTION XI - ECONOMIC JUSTIFICATION

57. COMPARISON OF BENEFITS AND COSTS

A primary criterion in determining the eligibility of the various components in the basin plan for authorization and construction is economic feasibility. Estimates of economic costs shown in SECTION IX and benefits presented in SECTION X were compared and are shown in TABLE 48.

TABLE 48
Benefit-cost ratios

	Net benefits	Annual charges*	Benefit-cost ratio
Main stream reservoirs			
2A, Pine Ford	$2,374,100	$1,200,800	2.0
5, Washington Park	758,800	737,500	1.03
9, Irondale	1,374,000	676,100	2.0
40, Virginia Mines	2,559,200	1,051,200	2.4
17, Meramec Park	4,678,300	1,941,800	2.4
27, Salem	838,900	699,100	1.2
29, Union	3,159,400	1,244,800	2.5
Tributary stream reservoirs			
I-14, Huzzah Creek	196,500	312,700	0.6
I-15A, Courtois Creek	273,500	320,300	0.85
I-21, Peavine Creek	95,400	145,900	0.7
I-23, Little Dry Fork Creek	373,700	264,500	1.4
I-26, West Fork Huzzah Creek	183,600	202,300	0.91
I-26 (with I-14 out)	225,500	202,300	1.1
I-28, Spring Creek	393,000	259,800	1.5
I-28 (with I-23 out)	463,200	259,800	1.8
I-30, Terre Bleue Creek	268,000	207,200	1.3
I-32, Redoak Creek	250,800	241,400	1.04
I-33A, Little Bourbeuse River	324,400	245,900	1.3
I-33A (with I-32 out)	328,400	245,900	1.3

TABLE 48 (Cont'd)

	Net benefits	Annual charges*	Benefit-cost ratio
I-35A, Brush Creek	$ 254,600	$ 250,600	1.02
I-35A (with I-32 out)	260,900	250,600	1.04
I-38, Bourbeuse River	590,200	343,800	1.7
I-41, Benton Creek	34,800	152,800	0.2
Headwater reservoirs			
H-3, Dry Creek	92,400	30,600	3.0
H-4, Cabanne Course	52,800	40,500	1.3
H-5A, Brady Creek	55,400	26,400	2.1
H-6, Birch Creek	160,800	49,300	3.3
H-8, Little Indian Creek	171,500	55,700	3.1
H-9, Bates Creek	55,000	30,400	1.8
H-10A, Lost Creek	40,600	25,800	1.6
H-11A, Winsell Creek	117,600	31,100	3.8
H-13A, Boone Creek	150,900	45,400	3.3
H-25, Big River	32,900	30,500	1.1
H-31, Dry Fork Creek	11,800	25,400	0.5
H-40, Coonville Creek	76,900	33,000	2.3

*Annual charges reflect economic costs.

58. ALLOCATION OF COSTS - RESERVOIRS

Reservoirs showing favorable benefit-to-cost ratios in TABLE 48 were further analyzed to determine the justification of each of the purposes served. The portion of costs chargeable to each purpose was determined by use of the separable costs-remaining benefits method, which consists of determining the separable cost of including each function in the multiple-purpose project and determining an equitable distribution of joint costs incurred for several purposes in common. This method of cost allocation is also based on the principles that each function should carry at least the separable cost of including it in the project and that no function should carry costs in excess of the amount of the benefits from this function or in excess of the alternative justifiable expenditure. A typical cost allocation is contained in APPENDIX T. Of the 31 reservoirs analyzed, six reservoirs, I-14,

I-15A, I-21, I-26, I-41, and H-31, had over-all benefit-cost ratios of less than unity. Five reservoirs, I-23, I-30, I-32, H-10A, and H-40, failed to meet the general criteria for justification. In reservoir I-23, water supply, water quality, and area reorientation are individually justified but the separable cost for recreation exceeds the least costly alternative. With recreation deleted as a purpose, the over-all benefit-cost ratio becomes less than unity. Flood control and area reorientation in reservoir I-30 have a benefit-cost ratio of unity; however, the separable cost for recreation exceeds the least costly alternative. Deletion of recreation as a purpose results in an unfavorable over-all benefit-cost ratio for this reservoir. In reservoir I-32, only recreation is justified, with water supply, water quality control, and area reorientation being less than unity. A single-purpose reservoir for recreation alone cannot be justified. While flood control and area reorientation are individually justified in reservoir H-10A, the separable cost for recreation exceeds the least costly alternative. Deletion of recreation results in an unfavorable over-all benefit-cost ratio for the reservoir. Reservoir H-40 has for its project purposes recreation and area reorientation. Recreation is not economically justified, the separable cost of which exceeds the least costly alternative. In each of these five reservoirs, storage is allocated to recreation. As outlined in SECTION VII, one of the criteria in the selection of reservoir sites is that it should permit complete development. Reservoir I-26 was reanalyzed with I-14 out and was found to have over-all justification as well as justification for each purpose. A reanalysis was made of reservoir I-28 with I-23 out and resulted in an increase in the benefit-cost ratio. Likewise, I-33A and I-35A were reanalyzed with I-32 out, resulting in increased benefits. While it is recognized that a lesser development might be favorable at some of the other sites, they were not investigated further, pending a determination of the ability of the remaining 21 reservoirs to meet the immediate and near future water needs of the basin. Cost allocation and benefit-cost ratios for the remaining main stream, tributary stream, and headwater reservoirs are shown in TABLES 49, 50, and 51. Benefit-cost ratios for various purposes are based on financial costs.

59. ANGLER-USE SITES

Angler-use sites were considered as groups and each group analyzed as a unit. Benefits attributed to these sites depend in part upon low-flow augmentation from the upstream reservoirs. Reservoirs affecting seven of these groups have been found to be economically

TABLE 49
Allocated costs - main stream reservoirs

Reservoirs	Flood control	Water quality	Water supply	Total recreation	Area reorientation	Navigation	Total
#2A Pine Ford							
Average annual benefits	$ 551,700	$ 120,100	$ 29,500	$ 1,110,900	$ 557,100	$ 10,700	$ 2,380,000
Average annual charges	375,000	61,300	14,600	438,500	203,600	3,900	1,096,900
Benefit-cost ratio	1.47	1.96	2.02	2.53	2.74	2.74	2.17
Allocated first costs	9,816,000	1,257,000	308,000	7,037,000	5,673,000	109,000	24,200,000
Allocated annual operation and maintenance	45,700	19,100	4,300	202,400	13,300	200	285,000
#5 Washington Park							
Average annual benefits	$ -	$ 193,900	$ 44,200	$ 287,900	$ 217,000	$ 16,100	$ 759,100
Average annual charges	-	184,200	41,700	276,600	204,000	15,100	721,600
Benefit-cost ratio	-	1.05	1.06	1.04	1.06	1.06	1.05
Allocated first costs	-	4,432,000	1,032,000	5,837,000	5,119,000	380,000	16,800,000
Allocated annual operation and maintenance	-	35,500	7,100	80,800	32,200	2,400	158,000
#9 Irondale							
Average annual benefits	$ 60,900	$ 448,100	$ 40,400	$ 500,700	$ 309,900	$ 14,800	$ 1,374,800
Average annual charges	54,900	155,200	21,200	269,300	138,700	6,600	645,900
Benefit-cost ratio	1.11	2.89	1.90	1.86	2.23	2.23	2.13
Allocated first costs	724,000	3,770,000	522,000	4,738,000	3,575,000	171,000	13,500,000
Allocated annual operation and maintenance	30,700	28,700	3,700	110,300	18,700	900	193,000
#40 Virginia Mines							
Average annual benefits	$ -	$ 20,300	$ -	$ 1,650,600	$ 890,700	$ -	$ 2,561,600
Average annual charges	-	14,100	-	673,300	280,900	-	968,300
Benefit-cost ratio	-	1.44	-	2.45	3.17	-	2.65
Allocated first costs	-	285,000	-	11,177,000	6,938,000	-	18,400,000
Allocated annual operation and maintenance	-	4,500	-	298,300	48,200	-	351,000
#17 Meramec Park							
Average annual benefits	$ 785,700	$ 546,400	$ 143,300	$ 2,197,100	$ 957,000	$ 57,100	$ 4,686,600
Average annual charges	411,700	217,400	43,900	791,900	257,400	15,400	1,737,700
Benefit-cost ratio	1.91	2.51	3.27	2.77	3.72	3.72	2.70
Allocated first costs	10,631,000	4,874,000	1,246,000	12,933,000	7,565,000	451,000	37,700,000
Allocated annual operation and maintenance	50,000	51,600	1,500	351,900	-	-	455,000
#27 Salem							
Average annual benefits	$ 74,100	$ 44,500	$ 17,200	$ 418,400	$ 284,700	$ -	$ 838,900
Average annual charges	73,800	44,000	17,000	262,200	280,900	-	677,900
Benefit-cost ratio	1.00	1.01	1.01	1.60	1.01	-	1.24
Allocated first costs	1,276,000	1,132,000	441,000	4,346,000	7,705,000	-	14,900,000
Allocated annual operation and maintenance	31,000	6,000	2,200	116,400	22,400	-	178,000
#29 Union							
Average annual benefits	$ 450,700	$ 431,900	$ 692,900	$ 975,200	$ 567,200	$ 47,300	$ 3,165,200
Average annual charges	244,900	104,200	237,000	395,700	130,200	10,900	1,122,900
Benefit-cost ratio	1.84	4.15	2.92	2.46	4.36	4.36	2.82
Allocated first costs	6,155,000	2,975,000	5,445,000	6,834,000	3,868,000	323,000	25,600,000
Allocated annual operation and maintenance	38,400	4,300	54,400	166,500	400	-	264,000

Note: Negative benefits have not been subtracted from totals.

TABLE 50
Allocated costs - tributary stream reservoirs

Reservoirs	Flood control	Water quality	Water supply	Total recreation	Area reorientation	Total
I-26 (w/I-14 out) West Fork Huzzah Creek						
Average annual benefits	$ 46,500	$ -	$ 6,600	$ 99,300	$ 73,100	$ 225,500
Average annual charges	46,400	-	6,600	71,600	72,900	197,500
Benefit-cost ratio	1.00	-	1.00	1.39	1.00	1.14
Allocated first costs	991,000	-	172,000	1,178,000	1,939,000	4,280,000
Allocated annual operation and maintenance	14,100	-	1,000	33,200	9,700	58,000
I-28 (w/I-23 out) Spring Creek						
Average annual benefits	$ 70,300	$ 129,800	$ 14,600	$ 142,500	$ 106,000	$ 463,200
Average annual charges	47,700	64,200	6,300	87,000	41,600	246,800
Benefit-cost ratio	1.48	2.02	2.30	1.64	2.55	1.88
Allocated first costs	908,000	1,321,000	169,000	1,284,000	1,098,000	4,780,000
Allocated annual operation and maintenance	18,000	21,100	900	45,100	5,900	91,000
I-33A (w/I-32 out) Little Bourbeuse River						
Average annual benefits	$ -	$ 155,900	$ 18,600	$ 82,300	$ 71,700	$ 328,500
Average annual charges	-	110,500	15,200	63,700	49,500	238,900
Benefit-cost ratio	-	1.41	1.22	1.29	1.45	1.38
Allocated first costs	-	2,511,000	341,000	1,124,000	1,174,000	5,150,000
Allocated annual operation and maintenance	-	28,600	4,200	27,000	11,200	71,000
I-35A (w/I-32 out) Brush Creek						
Average annual benefits	$ -	$ 148,900	$ 13,300	$ 65,800	$ 34,100	$ 262,100
Average annual charges	-	134,800	12,200	64,800	30,700	242,500
Benefit-cost ratio	-	1.10	1.09	1.02	1.11	1.08
Allocated first costs	-	3,217,000	278,000	957,000	748,000	5,200,000
Allocated annual operation and maintenance	-	30,000	3,200	33,500	6,300	73,000
I-38 Bourbeuse River						
Average annual benefits	$ 83,600	$ 143,100	$ 15,900	$ 225,500	$ 122,200	$ 590,300
Average annual charges	67,500	85,000	9,700	108,300	60,400	330,900
Benefit-cost ratio	1.24	1.68	1.64	2.08	2.02	1.78
Allocated first costs	1,006,000	1,618,000	211,000	1,253,000	1,522,000	5,610,000
Allocated annual operation and maintenance	34,700	32,300	2,700	67,500	10,800	148,000

Note: Negative benefits have not been subtracted from totals.

TABLE 51
Allocated costs - headwater reservoirs

Reservoirs	Flood control	Total recreation	Area reorientation	Total
H-3				
Average annual benefits	$ 26,600	$ 41,900	$ 23,900	$ 92,400
Average annual charges	8,600	12,600	6,600	27,800
Benefit-cost ratio	3.09	3.33	3.62	3.32
Allocated first costs	173,000	136,000	110,000	419,000
Allocated annual operation and maintenance	3,100	8,300	3,100	14,500
H-4				
Average annual benefits	$ -	$ 31,400	$ 21,400	$ 52,800
Average annual charges	-	20,800	16,500	37,300
Benefit-cost ratio	-	1.51	1.30	1.42
Allocated first costs	-	338,000	402,000	740,000
Allocated annual operation and maintenance	-	10,100	3,800	13,900
H-5A				
Average annual benefits	$ 16,200	$ 23,100	$ 16,100	$ 55,400
Average annual charges	11,100	11,200	2,700	25,000
Benefit-cost ratio	1.46	2.06	5.96	2.22
Allocated first costs	148,000	129,000	85,000	362,000
Allocated annual operation and maintenance	6,400	7,100	-	13,500
H-6				
Average annual benefits	$ -	$ 99,800	$ 61,000	$ 160,800
Average annual charges	-	26,400	18,200	44,600
Benefit-cost ratio	-	3.78	3.35	3.61
Allocated first costs	-	325,000	505,000	830,000
Allocated annual operation and maintenance	-	16,100	2,200	18,300
H-8				
Average annual benefits	$ 22,100	$ 92,100	$ 57,300	$ 171,500
Average annual charges	12,500	22,500	15,200	50,200
Benefit-cost ratio	1.77	4.09	3.77	3.42
Allocated first costs	309,000	313,000	398,000	1,020,000
Allocated annual operation and maintenance	2,700	12,600	2,600	17,900
H-9				
Average annual benefits	$ 14,600	$ 24,400	$ 16,000	$ 55,000
Average annual charges	10,600	11,000	6,300	27,900
Benefit-cost ratio	1.38	2.22	2.54	1.97
Allocated first costs	263,000	161,000	142,000	566,000
Allocated annual operation and maintenance	2,300	5,900	1,800	10,000
H-11A				
Average annual benefits	$ 17,500	$ 60,900	$ 39,200	$ 117,600
Average annual charges	6,600	13,400	7,600	27,600
Benefit-cost ratio	2.65	4.54	5.16	4.26
Allocated first costs	120,000	129,000	130,000	379,000
Allocated annual operation and maintenance	2,800	9,300	3,500	15,600
H-13A				
Average annual benefits	$ 24,700	$ 78,700	$ 47,500	$ 150,900
Average annual charges	14,500	15,500	10,400	40,400
Benefit-cost ratio	1.70	5.08	4.57	3.74
Allocated first costs	366,000	164,000	231,000	761,000
Allocated annual operation and maintenance	2,900	10,300	3,100	16,300
H-25				
Average annual benefits	$ 3,000	$ 18,400	$ 11,500	$ 32,900
Average annual charges	2,900	15,000	9,700	27,600
Benefit-cost ratio	1.03	1.23	1.19	1.19
Allocated first costs	54,000	270,000	247,000	571,000
Allocated annual operation and maintenance	1,200	6,500	1,900	9,600

justified in PARAGRAPH 58. Sites U and V, while justified as a group, depend upon reservoir I-15A which, as shown in TABLE 48, lacks justification at this time. Benefit-cost ratios for the eight groups of angler-use sites are shown in TABLE 52.

60. LOCAL PROTECTION

The nine levee areas included in the basin plan were evaluated based on the annual charges and benefits presented in SECTIONS IX and X, respectively. Six of the levee areas for which protection was studied were found to be economically justified. There are shown in TABLE 53 the benefit-cost ratios for the nine levee areas studied.

TABLE 52

Benefit-cost comparison, angler-use sites

Controlling reservoir	Site designation	Name	Benefits*	Average annual costs	Benefit-cost ratio
BIG RIVER SUB-BASIN					
Irondale (9)	A	Highway 8			
	B	Terre Bleue Creek			
	C	Highway E			
	D	Washington Park	$36,400	$20,800	1.8
Pine Ford (2A)	E	Morse Mill			
	F	Island			
	G	Cedar Hill			
	H	Rockford Beach			
	I	Meramec River confluence	47,500	24,700	1.9
MERAMEC RIVER SUB-BASIN					
Salem (27)	J	Wesco			
	K	Benton Creek			
	L	Highway 8	22,500	11,800	1.9
I-28 and/or Salem (27) (below Maramec Spring)	M	1,000 Oaks			
	N	Idlewild			
	O	Highway 19	22,500	11,900	1.9
Meramec Park (17)	P	Cove Church			
	Q	Little Meramec River			
	R	Robertsville	54,000	16,300	3.3

TABLE 52 (Cont'd)

Controlling reservoir	Site designation	Name	Benefits*	Average annual costs	Benefit-cost ratio
I-26	S	Huzzah			
	T	Highway 8	$16,200	$ 7,200	2.3
I-15A	U	Highway 8			
	V	Doss Branch	15,400	7,400	2.1
BOURBEUSE RIVER SUB-BASIN					
Union (29)	W	Beuscher Creek			
	X	Highway 50			
	Y	Highway 66			
	Z	Meramec River confluence	37,200	21,000	1.8

*All above angler-use sites below a reservoir analyzed as a total combined system.

TABLE 53
Benefit-cost comparison, local protection projects

	Levee area	Degree of protection	Anticipated land use	Benefits	Average annual costs*	Benefit-cost ratio
2	Telegraph Road	50-year	Truck farming	$ 20,000	$122,900	0.2
4	Starling Airport	50-year	Residential	136,100	127,700	1.1
5	Butler Lakes	50-year	Residential	217,100	187,600	1.2
7	Fenton	200-year	Urban - commercial	45,500	71,100	0.6
8	West Watson Road	200-year	Commercial	350,200	35,000	10.0
9	Weiss Airport	200-year	Commercial	384,100	69,700	5.5
11	Valley Park	200-year	Urban - commercial	70,100	65,900	1.1
12	Peerless Park	200-year	Commercial	627,300	104,500	6.0
17	Fox Creek	50-year	Agricultural	600	73,200	0.01

*Annual charges reflect economic costs.

SECTION XII - APPORTIONMENT OF COSTS

61. RESERVOIRS

The division of project costs between Federal and non-Federal interests was based on the allocation of costs to the project purposes as developed in SECTION XI and presently applicable laws and regulations governing cost-sharing practices. In accordance with the general principles of the Flood Control Act of 1936, all costs allocated to flood control are considered to be Federal. Costs allocated to water supply have been assigned to non-Federal interests in accordance with the Water Supply Act of 1958, as amended. Costs allocated to water quality control are defined as Federal cost, as provided under the Federal Water Pollution Control Act of 1961, since the benefits are widespread. Navigation and area reorientation costs also have been assigned to the Federal Government. Project costs allocated to recreation for the main stream and tributary stream reservoirs have been apportioned between Federal and non-Federal interests in accordance with the cost-sharing policy outlined in H. R. 9032, 88th Congress. Since headwater reservoirs are considered local flood control projects and not subject to the requirements of H. R. 9032, costs allocated to recreation have been assigned to the Federal Government in the amount of 25 percent of the total project cost plus the cost of facilities provided under Section 4 of the Flood Control Act as amended. The remainder of such costs allocated to recreation has been assigned to non-Federal interests. Apportionments of first costs and operation and maintenance, including major replacements, are shown in TABLES 54, 55, and 56 for the 21 reservoirs determined in SECTION XI to be economically justified in all respects.

62. COST APPORTIONMENT - WATER SUPPLY

Costs apportioned to water supply have been divided into two phases - those for storage required to meet the immediate and future needs over the first 50 years, and those for storage converted to meet the long-term needs covering the last 50 years of the period of analysis. Initial and future costs are shown in TABLE 57.

63. ANGLER-USE SITES

Total project first costs for these sites have been assumed to be a Federal responsibility. Operation and maintenance, including replacement of facilities, will be the responsibility of non-Federal interests. Apportionment of costs is shown in TABLE 58.

TABLE 54
Apportionment of costs - main stream reservoirs

(Costs in thousand dollars)

	Reservoir	Federal: Flood control Cost	Flood control Percent	Water quality Cost	Water quality Percent	Recreation Cost	Recreation Percent	Area reorientation Cost	Area reorientation Percent	Navigation Cost	Navigation Percent	Subtotal Cost	Subtotal Percent	Non-Federal: Water supply Cost	Water supply Percent	Recreation Cost	Recreation Percent	Subtotal Cost	Subtotal Percent	Total project cost
2A	Pine Ford																			
	First cost	9,816.0	40.56	1,257.0	5.20	6,934.0	28.65	5,673.0	23.44	109.0	0.45	23,789.0	98.30	308.0	1.27	103.0	0.43	411.0	1.70	24,200.0
	*O & M	45.7	16.03	19.1	6.70	202.4	71.02	13.3	4.67	0.2	0.07	280.7	98.49	4.3	1.51	-	-	4.3	1.51	285.0
5	Washington Park																			
	First cost	-	-	4,432.0	26.38	4,861.0	28.94	5,119.0	30.47	380.0	2.26	14,792.0	88.05	1,032.0	6.14	976.0	5.81	2,008.0	11.95	16,800.0
	*O & M	-	-	35.5	22.47	80.8	51.14	32.2	20.38	2.4	1.52	150.9	95.51	7.1	4.49	-	-	7.1	4.49	158.0
9	Irondale																			
	First cost	724.0	5.36	3,770.0	27.92	4,738.0	35.10	3,575.0	26.48	171.0	1.27	12,978.0	96.13	522.0	3.87	-	-	522.0	3.87	13,500.0
	*O & M	30.7	15.90	28.7	14.87	110.3	57.15	18.7	9.69	0.9	0.47	189.3	98.08	3.7	1.92	-	-	3.7	1.92	193.0
40	Virginia Mines																			
	First cost	-	-	285.0	1.55	7,967.0	43.30	6,938.0	37.70	-	-	15,190.0	82.55	-	-	3,210.0	17.45	3,210.0	17.45	18,400.0
	*O & M	-	-	4.5	1.28	298.3	84.99	48.2	13.73	-	-	351.0	100.00	-	-	-	-	-	-	351.0
17	Meramec Park																			
	First cost	10,631.0	28.20	4,874.0	12.93	12,933.0	34.30	7,565.0	20.07	451.0	1.19	36,454.0	96.69	1,246.0	3.31	-	-	1,246.0	3.31	37,700.0
	*O & M	50.0	10.99	51.6	11.34	351.9	77.34	-	-	-	-	453.5	99.67	1.5	0.33	-	-	1.5	0.33	455.0
27	Salem																			
	First cost	1,276.0	8.56	1,132.0	7.60	4,346.0	29.17	7,705.0	51.71	-	-	14,459.0	97.04	441.0	2.96	-	-	441.0	2.96	14,900.0
	*O & M	31.0	17.42	6.0	3.37	116.4	65.39	22.4	12.58	-	-	175.8	98.76	2.2	1.24	-	-	2.2	1.24	178.0
29	Union																			
	First cost	6,155.0	24.04	2,975.0	11.62	6,834.0	26.70	3,868.0	15.11	323.0	1.26	20,155.0	78.73	5,445.0	21.27	-	-	5,445.0	21.27	25,600.0
	*O & M	38.4	13.54	4.3	1.63	166.5	63.07	0.4	0.15	-	-	209.6	79.39	54.4	20.61	-	-	54.4	20.61	264.0
Grand total																				
	First cost	28,602.0		18,725.0		48,612.0		40,443.0		1,434.0		137,817.0		8,994.0		4,290.0		13,283.0		151,100.0
	O & M	195.8		149.7		1,326.6		135.2		3.5		1,810.8		73.2		-		73.2		1,884.0

*Includes replacement costs.

Note: Percentages are of total project cost.

TABLE 55
Apportionment of costs - tributary stream reservoirs

(Costs in thousand dollars)

Reservoir	Federal										Non-Federal				Total project cost
	Flood control		Water quality		Recreation		Area reorientation		Subtotal		Water supply		Subtotal		
	Cost	Percent	Cost	Percent	Cost	Percent	Cost	Percent	Cost	Percent	Cost	Percent	Cost	Percent	
I-26															
First cost	991.0	23.16	-	-	1,178.0	27.52	1,939.0	45.30	4,108.0	95.98	172.0	4.02	172.0	4.02	4,280.0
*O & M	14.1	24.31	-	-	33.2	57.24	9.7	16.73	57.0	98.28	1.0	1.72	1.0	1.72	58.0
I-28															
First cost	908.0	19.00	1,321.0	27.63	1,284.0	26.86	1,098.0	22.97	4,611.0	96.46	169.0	3.54	169.0	3.54	4,780.0
*O & M	18.0	19.78	21.1	23.19	45.1	49.56	5.9	6.48	90.1	99.01	0.9	0.99	0.9	0.99	91.0
I-33A															
First cost	-	-	2,511.0	48.76	1,124.0	21.82	1,174.0	22.80	4,809.0	93.38	341.0	6.62	341.0	6.62	5,150.0
*O & M	-	-	28.6	40.28	27.0	38.03	11.2	15.77	66.8	94.08	4.2	5.92	4.2	5.92	71.0
I-35A															
First cost	-	-	3,217.0	61.87	957.0	18.40	748.0	14.38	4,922.0	94.65	278.0	5.35	278.0	5.35	5,200.0
*O & M	-	-	30.0	41.10	33.5	45.89	6.3	8.63	69.8	95.62	3.2	4.38	3.2	4.38	73.0
I-38															
First cost	1,006.0	17.93	1,618.0	28.84	1,253.0	22.34	1,522.0	27.13	5,399.0	96.24	211.0	3.76	211.0	3.76	5,610.0
*O & M	34.7	23.45	32.3	21.82	67.5	45.61	10.8	7.30	145.3	98.18	2.7	1.82	2.7	1.82	148.0
Grand total															
First cost	2,905.0		8,667.0		5,796.0		6,481.0		23,849.0		1,171.0		1,171.0		25,020.0
*O & M	66.8		112.0		206.3		43.9		429.0		12.0		12.0		441.0

*Includes replacement costs.

Note: Percentages are of total project cost.

TABLE 56
Apportionment of costs,
headwater reservoirs

Reservoir	Federal								Non-Federal		Total project cost
	Flood Control		Recreation		Area Reorientation		Subtotal		Recreation		
	Cost	Percent	Cost	Percent	Cost	Percent	Cost	Percent	Cost	Percent	
H-3											
First cost	$173,000	41.29	$136,000	32.46	$110,000	26.25	$ 419,000	100.00	$ -	-	$ 419,000
*O & M	3,100	21.38	8,300	57.24	3,100	21.38	14,500	100.00	-	-	14,500
H-4											
First cost	-	-	228,000	30.81	402,000	54.33	630,000	85.14	110,000	14.86	740,000
*O & M	-	-	6,400	46.04	7,500	53.96	13,900	100.00	-	-	13,900
H-5A											
First cost	148,000	40.88	129,000	35.64	85,000	23.48	362,000	100.00	-	-	362,000
*O & M	6,400	47.41	7,100	52.59	-	-	13,500	100.00	-	-	13,500
H-6											
First cost	-	-	286,000	34.46	505,000	60.84	791,000	95.30	39,000	4.70	830,000
*O & M	-	-	16,100	87.98	2,200	12.02	18,300	100.00	-	-	18,300
H-8											
First cost	309,000	30.29	313,000	30.69	398,000	39.02	1,020,000	100.00	-	-	1,020,000
*O & M	2,700	15.08	12,600	70.39	2,600	14.53	17,900	100.00	-	-	17,900
H-9											
First cost	263,000	46.47	161,000	28.44	142,000	25.09	566,000	100.00	-	-	566,000
*O & M	2,300	23.00	5,900	59.00	1,800	18.00	10,000	100.00	-	-	10,000
H-11A											
First cost	120,000	31.66	129,000	34.04	130,000	34.30	379,000	100.00	-	-	379,000
*O & M	2,800	17.95	9,300	59.61	3,500	22.44	15,600	100.00	-	-	15,600
H-13A											
First cost	366,000	48.09	164,000	21.55	231,000	30.36	761,000	100.00	-	-	761,000
*O & M	2,900	17.79	10,300	63.19	3,100	19.02	16,300	100.00	-	-	16,300
H-25											
First cost	54,000	9.46	188,000	32.92	247,000	43.26	489,000	85.64	82,000	14.36	571,000
*O & M	1,200	12.50	6,500	67.71	1,900	19.79	9,600	100.00	-	-	9,600
Grand total											
First cost	1,433,000		1,734,000		2,250,000		5,417,000		231,000	-	5,648,000
*O & M	21,400		82,500		25,700		129,600		-	-	129,600

*Includes replacement costs.
Note: Percentages are of total project cost.

TABLE 57
Costs - water supply
(Costs in thousands of dollars)

Reservoir	1st 50 years Initial cost	1st 50 years Percent of project cost	2nd 50 years Additional cost	2nd 50 years Percent of project cost	Total cost	Percent of project cost
MAIN STREAM RESERVOIRS						
#2A Pine Ford						
First cost	$ -	-	$ 308.0	1.27	$ 308.0	1.27
*Operation and maintenance	-	-	4.3	1.51	4.3	1.51
#5 Washington Park						
First cost	-	-	1,032.0	6.14	1,032.0	6.14
*Operation and maintenance	-	-	7.1	4.49	7.1	4.49
#9 Irondale						
First cost	-	-	522.0	3.87	522.0	3.87
*Operation and maintenance	-	-	3.7	1.92	3.7	1.92
#40 Virginia Mines						
First cost	-	-	-	-	-	-
*Operation and maintenance	-	-	-	-	-	-
#17 Meramec Park						
First cost	-	-	1,246.0	3.31	1,246.0	3.31
*Operation and maintenance	-	-	1.5	0.33	1.5	0.33
#27 Salem						
First cost	-	-	441.0	2.96	441.0	2.96
*Operation and maintenance	-	-	2.2	1.24	2.2	1.24
#29 Union						
First cost	2,483.0	9.70	2,962.0	11.57	5,445.0	21.27
*Operation and maintenance	24.8	9.40	29.6	11.21	54.4	20.61
TRIBUTARY RESERVOIRS						
I-26 West Fork Huzzah Creek						
First cost	-	-	172.0	4.02	172.0	4.02
*Operation and maintenance	-	-	1.0	1.72	1.0	1.72
I-28 Spring Creek						
First cost	-	-	169.0	3.54	169.0	3.54
*Operation and maintenance	-	-	0.9	0.99	0.9	0.99
I-33A Little Bourbeuse River						
First cost	-	-	341.0	6.62	341.0	6.62
*Operation and maintenance	-	-	4.2	5.92	4.2	5.92
I-35A Brush Creek						
First cost	-	-	278.0	5.35	278.0	5.35
*Operation and maintenance	-	-	3.2	4.38	3.2	4.38
I-38 Bourbeuse River						
First cost	-	-	211.0	3.76	211.0	3.76
*Operation and maintenance	-	-	2.7	1.82	2.7	1.82
Total main stream and tributary stream reservoirs						
First cost	$2,483.0		$7,682.0		$10,165.0	
*Operation and maintenance	24.8		60.4		85.2	

* Include replacement costs.

Note: Percentages are of total project cost.

TABLE 58
Apportionment of costs - angler-use sites

Controlling reservoir	Site designation	Name	Project first costs Federal responsibility	Total operation and maintenance costs non-Federal responsibility
BIG RIVER SUB-BASIN				
Irondale (9)	A	Highway 8		
	B	Terre Bleue Creek		
	C	Highway E		
	D	Washington Park	$117,000	$16,300
Pine Ford (2A)	E	Morse Mill		
	F	Island		
	G	Cedar Hill		
	H	Rockford Beach		
	I	Meramec River confluence	134,000	19,500
MERAMEC RIVER SUB-BASIN				
Salem (27)	J	Wesco		
	K	Benton Creek		
	L	Highway 8	84,000	8,500
I-28 and/or Salem (27) (below Maramec Spring)	M	1,000 Oaks		
	N	Idlewild		
	O	Highway 19	84,000	8,600
Meramec Park (17)	P	Cove Church		
	Q	Little Meramec River		
	R	Robertsville	84,000	13,000

TABLE 58 (Cont'd)

Controlling reservoir	Site designation	Name	Project first costs Federal responsibility	Total operation and maintenance costs non-Federal responsibility
MERAMEC RIVER SUB-BASIN (continued)				
I-26	S	Huzzah		
	T	Highway 8	$ 50,000	$ 5,300
I-15A	U	Highway 8		
	V	Doss Branch	50,000	5,500
BOURBEUSE RIVER SUB-BASIN				
Union (29)	W	Beuscher Creek		
	X	Highway 50		
	Y	Highway 66		
	Z	Meramec River confluence	117,000	16,500
Total costs			$720,000	$93,200

64. LOCAL PROTECTION

Of the total project first costs, non-Federal interests will furnish all lands, easements, and rights-of-way; bear all property damage costs; and pay for alterations and relocations of roads and utilities; and the remainder of the first costs will be borne by the Federal Government. Non-Federal interests will bear all operation and maintenance expenses for the project. The apportionment of costs for each of the six areas found economically justified in SECTION XI is shown in TABLE 59.

TABLE 59
Apportionment of costs - local protection projects

Levee area	Project first costs			Annual operation and maintenance costs
	Federal	Non-Federal	Total	Non-Federal
Starling Airport (No. 4)	$ 2,350,000	$ 378,000	$ 2,728,000	$ 20,000
Butler Lakes (No. 5)	3,230,000	339,000	3,569,000	46,000
West Watson Road (No. 8)	698,000	193,000	891,000	6,000
Weiss Airport (No. 9)	1,430,000	220,000	1,650,000	16,000
Valley Park (No. 11)	1,350,000	289,000	1,639,000	11,000
Peerless Park (No. 12)	1,910,000	383,000	2,293,000	30,000
Total costs	$10,968,000	$1,802,000	$12,770,000	$129,000

SECTION XIII - COORDINATION WITH OTHER AGENCIES

65. COOPERATION AND COORDINATION

To meet the basic objective of developing a fully coordinated plan to provide for the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs, the views and recommendations of all interested Federal, State, and local agencies were solicited and considered throughout the study. FIGURE 24 shows the various agencies and groups that participated and individuals designated to coordinate at field level.

66. COORDINATING METHODS EMPLOYED

Directors of participating agencies were notified upon initiation of the study that it would be fully coordinated with, and take into consideration the programs of, all interested agencies. A procedure of meeting with task groups for study of various problems was agreed upon. A tentative plan of development, consisting of the 31 reservoirs and 9 levee systems, which had been selected for detail study, was made available to all participants. In September 1962, the plan under consideration was presented to the public by means of an Information Bulletin. Coordination was effected throughout this study with the Meramec Basin Corporation and the Meramec Basin Research Project, sponsored jointly by the Corporation and Washington University. The report of the Meramec Basin Research Project, included as APPENDICES A and B to this report, was used in the economic base survey. During the course of the study, three meetings of all participating agencies were held in the St. Louis District office, the first to report on the progress of agency studies and exchange views; the second to present the results of economic evaluation of the main stream and tributary stream reservoirs and solicit recommendations as to which improvements should be considered for authorization and construction within the next 10 to 15 years; and the third to review the economic justification of the headwater reservoirs, downstream angler-use sites, and local protection projects and obtain recommendations as to which of these improvements should be considered for authorization and construction within the next 10- to 15-year period. In addition to the three meetings, further coordination was accomplished through discussions, action advisory letters, and conferences with individual agencies. Further coordination with the Meramec Basin Corporation was accomplished by attendance at

James Maas
Assistant

FEDERAL AGENCIES

DEPARTMENT OF THE INTERIOR AGENCIES

Robert W. Burwell, Regional Director
Bureau of Sport Fisheries and Wildlife
North Central Region
Minneapolis 8, Minnesota

Roman H. Koenings, Field Director
Bureau of Outdoor Recreation
Lake Central Field Office
Ann Arbor, Michigan

Howard W. Baker, Regional Director
National Park Service
Midwest Region
Omaha, Nebraska

Douglas G. Wright, Administrator
Southwestern Power Administration
Tulsa, Oklahoma

Robert S. Sanford
Acting Regional Director
Region IV
Bureau of Mines
Bartlesville, Oklahoma

Anthony Homyk, District Engineer
Water Resources Division
U. S. Geological Survey
Rolla, Missouri

Daniel Kennedy, Regional Engineer
Topographic Division
U. S. Geological Survey
Rolla, Missouri

DEPARTMENT OF AGRICULTURE AGENCIES

Howard C. Jackson
State Conservationist
Soil Conservation Service
Columbia, Missouri

A. L. Richey, Chief Cooperative
Watershed Management Branch
Forest Service
North Central Region
Milwaukee, Wisconsin

C. L. Harrison, Forest Supervisor
Clark National Forest
Rolla, Missouri

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

William H. Davis
Chief, Water Resources Section
Water Supply and Pollution Control
Public Health Service
Kansas City, Missouri

FEDERAL POWER COMMISSION

Kenneth G. Tower
Regional Engineer
Chicago, Illinois

A

Forrest
St. Lou

Director
Industri
Director
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Director

Director
State H
Executi
Water
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COORDINATION CHART
IDENTIFICATION OF PERSONNEL

U. S. ARMY ENGINEER DISTRICT,
ST. LOUIS
CORPS OF ENGINEERS

Col. A. J. D'Arezzo
District Engineer
July 1960 - April 1963

Col. J. B. Meanor, Jr.
District Engineer
July 1963 -

W. F. Lawlor
Chief, Engineering Division

A. J. Tiefenbrun
Chief, Basin Planning Branch

James Maas
Assistant

D. W. Gifford
Head, Meramec Basin Section
Coordinator

A. L. Alin
Engineer Consultant
Omaha, Nebraska

STATE AGENCIES

LOCAL ORGANIZATIONS

OWER COMMISSION
ower
ineer
ois

AREA REDEVELOPMENT ADMINISTRATION
Forrest E. Koch, Missouri Coordinator
St. Louis, Missouri

MEMBERS
Director, Division of Commerce and Industrial Development
Director, Missouri Conservation Commission
Director of Parks
Director of Information, Missouri State Highway Department
Executive Secretary
Water Pollution Board
Secretary, Missouri Boat Commission

THE GOVERNOR'S ADVISORY COMMITTEE
Haysler A. Pogue, Chairman
Jefferson City, Missouri
Also Chairman of the Water Resources Board

WATER RESOURCES BOARD
Clifford L. Summers
Executive Director
Jefferson City, Missouri

DIVISION OF COMMERCE & INDUSTRIAL DEVELOPMENT
E. B. Kinder
Travel and Recreation Director
Jefferson City, Missouri

MISSOURI STATE PARK BOARD
Joseph Jaeger, Jr.
Director
Jefferson City, Missouri

MISSOURI CONSERVATION COMMISSION
William E. Towell, Director
Jefferson City, Missouri

MISSOURI BOAT COMMISSION
J. T. Johnson, Secretary
Jefferson City, Missouri

WATER POLLUTION BOARD
Jack K. Smith
Executive Secretary
Jefferson City, Missouri

MISSOURI STATE HIGHWAY COMMISSION
M. J. Snider, Chief Engineer
Jefferson City, Missouri

DIVISION OF GEOLOGICAL SURVEY AND WATER RESOURCES
Thomas R. Beveridge
State Geologist
Rolla, Missouri

UNIVERSITY OF MISSOURI EXTENSION SERVICE
Hugh Denny, Chairman
Columbia, Missouri

MERAMEC BASIN CORPORATION
Leo A. Politte, President
Kirkwood, Missouri

James F. Gamble, Chairman
Meramec Basin Cooperative Planning Commission

Robert R. Wellborn
Vice-Chairman
Legal Asst. to Governor Dalton
Jefferson City, Missouri

David F. Crossen, Chairman
Recreation Sub-Committee
Brentwood, Missouri

Clifford L. Summers, Chairman
Water Sub-Committee
Jefferson City, Missouri

L. G. Williams, Chairman
Sub-Committee, Commerce and Industry
Union, Missouri

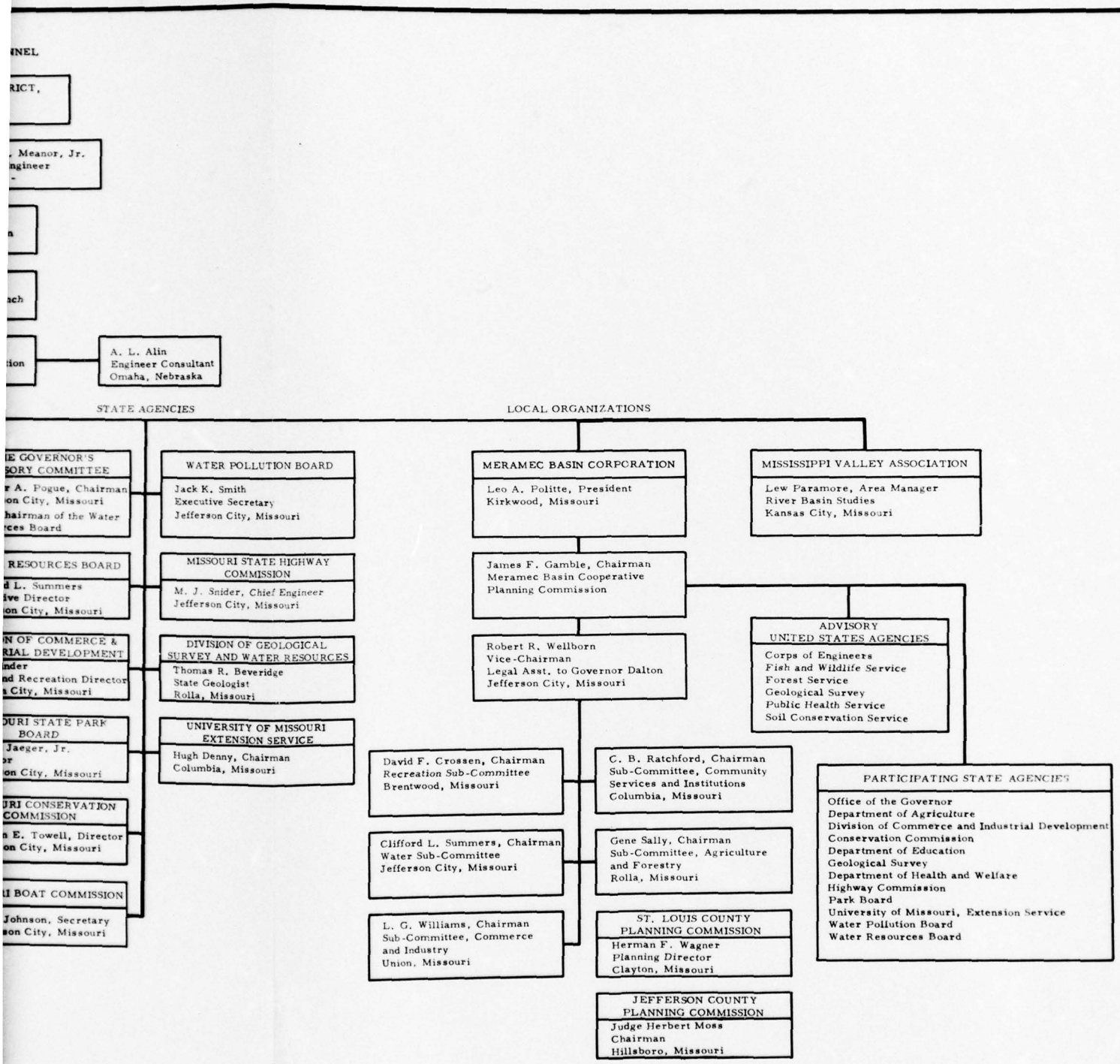
C. B. Ratchford, Chair
Sub-Committee, Comm
Services and Institution
Columbia, Missouri

Gene Sally, Chairman
Sub-Committee, Agric
and Forestry
Rolla, Missouri

ST. LOUIS COUN
PLANNING COMMIS
Herman F. Wagner
Planning Director
Clayton, Missouri

JEFFERSON COU
PLANNING COMMI
Judge Herbert Moss
Chairman
Hillsboro, Missouri

BASIN S



BASIN STUDY PARTICIPANTS

the regularly scheduled meetings of the Board of Directors, at which times progress reports were given and views exchanged. Coordination with individuals and groups was achieved by means of two public hearings, the first upon initiation of the study, on 7 April 1961, and the second upon formulation of the basin plan, on 18 December 1963. A digest of views expressed is contained in APPENDIX S. Views were also obtained at meetings held with various organizations and groups throughout the area.

67. EXTENT OF PARTICIPATION AND VIEWS

a. U. S. Department of Health, Education, and Welfare - Public Health Service. The Public Health Service determined the municipal and industrial water supply requirements and the need for low-flow augmentation in the interest of water quality control. The U. S. Bureau of Mines, U. S. Forest Service, National Park Service, U. S. Fish and Wildlife Service, Missouri Water Pollution Board, and State Division of Geological Survey and Water Resources also assisted in this study. The Public Health Service report is contained in APPENDIX L. The Public Health Service has expressed the following views:

> ". . . reservoir storage will not be needed for municipal and industrial water supplies in the Upper Basin. In the Lower Basin, additional water will be needed by 1995 for municipal and industrial water, either from reservoir storage in the basin or from a source outside the basin.
>
> ". . . it is apparent that reservoir storage for streamflow regulation for quality control will be needed during the study period.
>
> "Our studies to date indicate that the following reservoirs should be constructed during the next 15 years:
>
> I-38 on Bourbeuse River
> No. 29 on Bourbeuse River
> No. 9 on Big River
>
> "We suggest that reservoirs No. 9 and I-38 have top priority, and No. 29 second priority."

The Public Health Service also stated that the headwater reservoirs lack sufficient joint-use storage capacity to make any significant contribution

to water quality control, and, consequently, it has made no comment in regard to the need for authorization of any of the headwater reservoirs.

b. U. S. Department of Agriculture.

(1) Soil Conservation Service. A study of the Meramec River Basin has been initiated by the Soil Conservation Service in accordance with Section 6, Public Law 566, as amended, and is being coordinated with the Corps of Engineers. The Soil Conservation Service study will include an inventory of the land and land pattern developments and recommendations for improved farming practices best suited to land types. Recreation is recognized as an important land use. The Soil Conservation Service furnished designs and cost estimates for the 12 headwater sites which were selected for detailed study. The Department of Agriculture has prepared the following appendices to the report:

APPENDIX G - PART 1 - PHYSICAL LAND CONDITION
PART 2 - DESIGN AND COST ESTIMATES FOR HEADWATER RESERVOIRS

APPENDIX H - PLAN OF PARTICIPATION BY U. S. DEPARTMENT OF AGRICULTURE

APPENDIX I - REPORT ON FOREST RESOURCE POTENTIAL

The Soil Conservation Service stated that:

"The Department of Agriculture Field Advisory Committee is not in a position at this time to:

"1. Recommend the projects that should be retained in the plan for the long-range development of the Basin.

"2. Recommend the projects for which authorization should be requested and construction undertaken within the next ten to twenty-year period.

"At a later date we should know how the interdependence of structures will blend themselves into a comprehensive watershed program for the Meramec River Basin."

(2) Forest Service. The Forest Service provided projections of the effect of development of the wood industry on water requirements to the Public Health Service. A report was also submitted by the Forest Supervisor, Clark National Forest on the impact of the basin plan on the Clark National Forest. This report is included as APPENDIX N. The following statement is contained in the report with regard to management responsibilities:

> "Public interests and values represented by recreation and other uses which will be created or affected by this project would appear to be most effectively and economically served by having a single public agency responsible for the administration and management of all lands and facilities surrounding the reservoir which are not needed for flood control works. This could be facilitated by giving National Forest status to all lands acquired by the United States for, and in connection with, the Meramec Basin Project within the exterior boundaries of the Clark National Forest. . ."

The U. S. Forest Service expressed the following views with regard to improvements which should be recommended for authorization:

> ". . . It is believed the best overall correlation of recreation and wildlife programs would be facilitated by the construction of at least one reservoir within the Clark National Forest. Since I-26 has the most favorable benefit-cost ratio of the 'I-' reservoirs within the National Forest, it is recommended for construction within the first construction period.
>
> "The lower reaches of Huzzah and Courtois Creeks are among the most heavily fished streams in the Ozarks. Flooding of these streams by backwaters of the Meramec Park Reservoir will reduce the fishing quality on approximately eleven miles of these scenic, clear streams. In addition, their potential for Forest-type recreation will be diminished.
>
> "Provision of multiple outlets in I-26 for control of temperature and composition of downstream releases as well as fluctuation of flow will provide a suitable environment for warm water fishing on the balance of this stream and mitigate the fishing losses in the lower reaches of Huzzah and Courtois Creeks."

c. U. S. Department of the Interior.

(1) Geological Survey. This agency assisted in the water survey studies undertaken by the Missouri Water Pollution Board and participated in a ground water program undertaken in cooperation with the Missouri State Geological Survey. Maps of the Meramec Basin, prepared by the U. S. Geological Survey, were used throughout the study.

(2) Bureau of Mines. The Bureau evaluated the impact of the proposed reservoir system on the mining industry in the basin, including the needs for water supply and the effects of mining operations on water quality. The study of economic projections and effects on water quality and water supply was furnished the Public Health Service. A report prepared by this agency, entitled "Mineral Resources and Mineral Industry of the Meramec River Basin, Missouri", is included as APPENDIX J.

(3) Fish and Wildlife Service. The Fish and Wildlife Service evaluated fish and wildlife aspects of the basin, including effects of the plan of improvement under consideration by the Corps of Engineers. The agency recommended additional parcels of land downstream from the reservoirs and adjacent to the streams be provided as angler-use sites for float fishing. Multiple-level intakes in conduits were recommended to provide temperature and oxygen content in downstream releases suitable for warm water fisheries. The effects of flood protection and change in land use were evaluated and a request was made that specific areas be acquired to mitigate the adverse effects on wildlife. The agency's report is contained in APPENDIX O. The Fish and Wildlife Service has expressed the following views in regard to priority of construction of the reservoirs:

> "We recommend that initial construction begin at Sites #29, #2A, and #40, in descending order of priority. Large impoundments in the vicinity of the City of St. Louis are necessary to satisfy that metropolitan area's needs for water-oriented recreation associated with fish and wildlife. These sites are strategically located near major highways radiating from the City and as such their accessibility is assured. We favor early construction of Site #9 to serve the fish and wildlife resources needs of the heavily populated southeastern portion of the Meramec Basin. In addition, an impoundment in this area

would help fulfill the expanding recreational requirements of the City of St. Louis.

"The establishment of a small reservoir in the rugged terrain of Clark National Forest would supply a Basin need for an impoundment in a wilderness-type setting, with extensive adjoining public lands for wildlife recreation. A reservoir at the Site I-26 in the Huzzah Creek headwaters also would have these desired advantages. Moreover, it would satisfy sport fishing needs for residents in the southeastern portion of the Basin.

"Finally, it would be desirable to provide a reservoir at Site #I-38 in the northwestern corner of the Basin to increase fish and wildlife recreation opportunities for residents in that area.

"We have not included other sites in our priority scheme. However, the need for impoundments at additional sites after the initial construction period appears certain to develop.

"A reservoir at Site #17 would result in substantial fish and wildlife losses and we wish to go on record as being opposed to its development.

"In the interest of comprehensive fish and wildlife planning we favor the eventual inclusion of all remaining major and intermediate sites. Supplementation of those sites by a series of headwater sites is believed essential for full development of a balanced project, designed to realize the fine potentials of this Basin for fish and wildlife."

This agency subsequently expanded its views in regard to Site 17 as follows:

"Our October 31, 1963 letter stated opposition to Site 17 because it would result in substantial fish and wildlife losses. We wish to amplify that statement. We feel strongly that Site 17 should not be included in the initial group of major sites--those to be selected for construction

in the next 10 to 15 year period. In reaching this conclusion, we are in agreement with the Missouri Conservation Commission that the reach of Meramec River which would be destroyed by a reservoir at Site 17 is one of the finest clear-water stream sections remaining in the Ozarks and should be preserved if at all possible. This is a stream section with unusually high values, both tangible and intangible. There is no practicable means of mitigating the stream-fishery losses in kind. Accordingly, we believe that Site 17 should be deferred in your planning and that it should be assigned a low priority in any construction schedule.

"Relative to the monetary values assigned to Site 17 and the other reservoirs in Mr. Peterson's letter of June 11, 1963, we would like to emphasize that this is preliminary data and is subject to change. We recognize that a reservoir at Site 17 is a key feature in providing flood control in Meramec Basin. Consistent with our obligations under the Fish and Wildlife Coordination Act, however, our evaluations of project effects must necessarily relate purely to the fish and wildlife considerations."

(4) Bureau of Outdoor Recreation and National Park Service. The Bureau of Outdoor Recreation and the National Park Service have submitted a joint report for the Meramec Basin study, entitled "Recreation Needs as Related to Reservoir System Formulated", contained in APPENDIX M. Their report includes recommendations for priority of construction for the basin's recreational needs, the anticipated initial visitor-day attendance, and the initial development cost of the required recreational facilities. The National Park Service prepared the land development and operation and maintenance costs, based on attendance estimates made by the Bureau of Outdoor Recreation. The Bureau also prepared the recreational benefit estimates. The Bureau of Outdoor Recreation and the National Park Service have expressed the following views:

". . . It is our understanding that the Forest Service desires to plan and administer recreation on all reservoir associated lands within the National Forest. Administration by the Forest Service is logical and we recommend

that such an arrangement be proposed in your report. Administration of recreation facilities by the Corps of Engineers within the National Forest, when the Forest Service, too, develops and administers recreation facilities, is unnecessary duplication. It is our feeling, also, that funds for recreation development on Forest associated reservoirs should be obtained under project authorization and appropriations."

(5) Southwestern Power Administration. The Southwestern Power Administration in reviewing the hydroelectric power potential expressed the following views:

"We feel that your office has thoroughly studied the possibilities of inclusion of hydropower in the comprehensive plan. However, based on data which you have supplied us there is no power plan in which the power costs of the project can be recovered by marketing power under the current marketing experience of this Administration. We foresee no radical changes in either the cost of hydroelectric power installation or the price of electric power that would cause the construction of power facilities to later be justified at the projects studied."

d. Federal Power Commission. The Commission furnished pertinent power values, area-load duration curves, and reviewed all proposals for power. Data prepared by the Commission are contained in APPENDIX F. The Federal Power Commission expressed the following views:

"Our power studies have shown that there is a potential power market for 10-percent (or less) plant-factor generating installations for 250,000 kilowatts at Salem, 400,000 kilowatts at Pine Ford, and 360,000 kilowatts at Meramec Park. Conventional economic analyses indicated that on a basis of specific power costs (which in the case of the Meramec River Basin projects are also separable costs) the B/C ratios for these three projects would range from 1.35 to about 1.50. Although we have not received information from your office as to the allocated joint

costs which might be chargeable to power at these three projects, it in no event appears that the B/C ratios would be reduced to less than unity by consideration of these charges.

"Pursuant to the foregoing we recommend that you include in your comprehensive Basin report a presentation of the three hydroelectric projects suggested. We do not suggest that you recommend authorization of the construction of these projects; however, we believe the report should state that although presenting a favorable picture on the basis of conventional economic analyses, the power developments are not recommended for authorization by reason of the fact that the Southwestern Power Administration has stated they cannot dispose of the power output at the prices indicated.

"At the meeting in your office on October 15 it is understood the SPA representative stated that his Agency could obtain pumped storage power in Arkansas at lower costs than those indicated for the Meramec River Basin. It is likely that there are higher heads in Arkansas and that the unit cost for pump-back hydroelectric power there would be less than in the Meramec Basin. However, it is our view that Meramec Basin power would be integrated with electric power resources in the Illinois-Missouri power pool (PSA's 15 and 40), and possibly also with those in the Kansas City area. There is some question that projects in Arkansas could compete with Meramec Basin projects in this market area due to the likely greater transmission costs required to properly integrate these more remote plants with the electric power supply in the market area considered."

e. U. S. Department of Commerce - Area Redevelopment Administration. The Area Redevelopment Administration assisted in developing data whereby project benefits from economic development in the area could be evaluated.

f. Missouri State agencies.

(1) Division of Geological Survey and Water Resources. The State Geologist actively assisted the Corps of Engineers in

collecting and furnishing geological data and prepared a report on "Groundwater Use and Production Capabilities", which is included as APPENDIX K. This report also served the U. S. Public Health Service in evaluating the projected needs for water supply. The Division of Geological Survey and Water Resources expressed the following views:

> "The Meramec River Basin Study as presented in the Oct. 15, 1963, meeting outlines an adequate and workable basin development program from the view point of the Missouri Geological Survey. Since the ground water and bedrock in the basin are our main concern, this endorsement is necessarily limited to these features. The selection of four intermediate and seven major sites for early consideration is certainly in line with the geologic suitability of these selected sites."

(2) State Park Board. The Board cooperated with the National Park Service in determining recreation developments to be installed at various reservoirs under study. The following specific recommendations have been made by the Park Board:

"1. The Missouri State Park Board has no funds available at this time nor can the Board assure funds for recreational development from the State of Missouri for the non-federal contributions toward recreational benefits. Participation in non-federal contributions toward recreational benefits must depend upon appropriations from general revenue by the legislature.

"2. It is requested that the Missouri State Park Board receive an amount equal to the replacement costs for all buildings and facilities to be inundated at Meramec and Washington State Parks.

"3. It is requested that all inundated state park land be replaced with land above the conservation pool or similar level in fee title.

"4. It is requested that the water level on Meramec Park Reservoir be fairly constant.

"5. It is requested that the power distribution point for the Meramec Park Reservoir be located so that most of the power lines will not be on existing state park property. I understand this has been done at Norfork Reservoir. At the present time we have an approximate quarter mile wide power right-of-way across Table Rock State Park; we do not feel this is compatible with a state park.

"6. It is requested that consideration be given to withdrawing the policy of the Corps of Engineers of requiring an equal number of free campsites before a charge can be made on licensed areas.

"7. It is recommended that the joint land acquisition policy of the Corps of Engineers and Department of Interior as now in effect be the guide for purchasing land.

* * *

"The above comments are in no way to mean that this department opposes the Meramec Basin Project."

(3) Water Pollution Board. The Board undertook a stream survey in the Meramec Basin and collected field data with a portable laboratory. It has established 80 stations at which it is continuing to collect data, which are being furnished to the Public Health Service. The Board held a public hearing on 22 July 1963 in Union, Missouri, regarding pollution in the Meramec River, at which time statements were presented by various Federal agencies.

(4) State Highway Commission. The Commission has reviewed the road relocations in the basin plan and stated that its future improvements will be planned so as to minimize relocations due to reservoirs. The Highway Commission expressed the following views in regard to the main stream and tributary stream reservoirs:

"As we were represented at the meeting in St. Louis on October 15, 1963, concerning the economic analysis of major and intermediate reservoirs considered in the Meramec River Basin Study and have reviewed the data

presented at that time, this is to advise that we have no changes to recommend in the findings that were presented."

(5) Conservation Commission. The Commission has assisted the U. S. Fish and Wildlife Service in coordinating that agency's responsibilities in connection with the current study of the Meramec River Basin. The Conservation Commission has presented the following views:

"The Missouri Conservation Commission now owns and manages 6,078 acres of land in its Huzzah wildlife area. Some 900 acres of this land will be inundated by Meramec Park Reservoir. The Missouri Conservation Commission has requested 4,400 acres be acquired and made available to that agency for the Huzzah wildlife area in mitigation for terrestrial habitat inundated by the proposed reservoir system for the Basin. The Governor's Advisory Committee on the resurvey of the Meramec Basin also recommends that all of the 4,400 acres requested by the Missouri Conservation Commission in mitigation for terrestrial habitat inundated by the reservoir system be acquired for addition to the Huzzah wildlife area. It is proposed to buy sufficient land to add to the Huzzah wildlife area to mitigate for the 900 acres inundated by the reservoir in that agency's holdings, plus an additional 600 acres. These lands would be acquired to block in Commission ownership between the Huzzah wildlife area and the reservoir. The Conservation Commission and the U. S. Fish and Wildlife Service have indicated they will accept the remaining 2,900 acres within the boundaries of lands designated by the Bureau of Outdoor Recreation. These 2,900 acres would be for the primary purpose of wildlife management, i.e. adjacent to the Huzzah area and on the south side of the reservoir along the Meramec or Huzzah."

In addition, the following specific comment has been received from the Commission with respect to the opposition expressed by the U. S. Fish and Wildlife Service in regard to construction of Site 17, Meramec Park Reservoir:

"Reviewing our file of the Meramec Basin studies, we have discovered a paragraph in a letter sent to you by Regional Director . . . of the Fish and Wildlife Service on October 31 of this year which may need clarification.

"The paragraph in question is at the top of page 2 of . . . letter to you on that date and reads as follows: 'A reservoir at Site #17 would result in substantial fish and wildlife losses and we wish to go on record as being opposed to its development.'

"The context of the letter in question was in regard to construction priority, not in opposition to any reservoir per se, however, we would like to make it clear that the paragraph as quoted does not mean this department is opposed to construction at Site #17 of the Meramec Park Reservoir.

"I am sure that our position on all these reservoirs and on the plan as a whole has been and is being clarified in our work with the Governor's Advisory Board and our technical studies within the Basin. We simply want to make the record clear that we do not oppose construction of the Meramec Park Reservoir. We have testified in letters to you and in statements made by the Governor's Advisory Committee that the Meramec Park Reservoir will result in greater losses to wildlife and forestry than in any other reservoir in the Basin. And, of course, we have asked for certain mitigations here in terms of land since this reservoir would inundate more than 900 acres of the Huzzah Wildlife Area, but we are not on record as opposing its construction."

(6) Division of Commerce and Industrial Development. The Division assisted in evaluating the economic impact of the proposed plan of improvement on the commerce and industry of the basin.

(7) Boat Commission. The management of water-based recreation in the reservoirs proposed for authorization will be fully coordinated with the Boat Commission.

(8) University of Missouri Extension Service. The Extension Service is presently assisting local groups in organizing so that they may effectively support zoning, urban affairs, and allied concepts related to water resources development.

(9) The Governor's Advisory Committee. The Governor appointed the Chairman of the Water Resources Board to act as Chairman of the Advisory Committee and to report to him the views of the State agencies having an interest in the report of the Corps of Engineers. The Governor's Advisory Committee expressed the following views:

"The following comments are made in regard to state and local participation in project costs and in regard to priorities for reservoir construction within the next 15 years.

"1. The committee is in agreement with the joint land acquisition policy of the Corps of Engineers and Department of Interior as now in effect. It is requested, however, that any deviations from this policy be submitted to the State of Missouri for approval or disapproval prior to the actual acquisition of land at an appropriate time.

"2. . . . It is the opinion of the Governor's Advisory Committee on the Resurvey of the Meramec Basin that provisions for future water supply storage should be included in the comprehensive plan for the development of the water resources of the basin.

"3. At the present time there are no funds available to any of the Missouri State Agencies which can be used for the purpose of water supply storage in federal reservoirs. The Missouri Water Resources Board has been instructed by the Missouri legislature to investigate and to recommend a means whereby state and local obligations for water supply

storage can be met. A plan will be presented to the 73rd General Assembly which will meet in January, 1965. However, reaction of the legislature and future legislatures to the proposal of the Water Resources Board can not be predicted and for this reason no assurance or the method of repayment can be made at this time.

"4. Apportionment of project costs also requires non-federal contributions toward recreational benefits. At present there are no funds available for recreational development from the State of Missouri for participation in meeting projects costs. The need for the recreational facilities proposed in the Corps of Engineers report is recognized. However, as with water supply storage no firm assurance for state or local participation can be made at this time. Future participation would be dependent upon appropriations from general funds by the legislature.

"5. Federal law provides for wildlife enhancement as a project purpose on a non-reimbursable basis, and the application of a policy of providing wildlife features on a non-reimbursable basis is recommended in the development of the Meramec Basin.

"6. The following reservoirs are recommended for authorization and construction within the next 15 years with the priorities designated in the following listing:

Priority No. 1	#29	Union
Priority No. 2	#17	Meramec Park
Priority No. 3	#9	Irondale
Priority No. 4	#27	Salem
Priority No. 5	#2A	Pine Ford
Priority No. 6	#I 38	Bourbeuse
Priority No. 7	#5	Washington Park
Priority No. 8	#40	Virginia Mines"

The following views represent the coordinated views of all of the State agencies:

"There is general feeling that headwater structures should not be included in the request for authorization for construction by the Corps of Engineers. This feeling is prompted by the confusion and possible harm to future soil conservation programs as a result of misunderstanding over the local participation requirements under the SCS program.

"Experience indicates that the small watershed development and the attractions of flood control impoundments associated with small watersheds are contributory to the acceptance by the farmers toward application of terracing, grassed waterways and retarding structures provided by each land owner. It is suggested, therefore, that your report recognize the possibilities of additional flood control and other beneficial uses associated with 'H' structures in a manner that will permit future development by soil and water districts and subdistricts established under the provisions of Missouri law.

"The above comments would, of course, only apply to those structures located on private lands outside the boundaries of the Clark National Forests. If the 'H' sites or intermediate sites within the boundaries of the Forests can be economically justified, there is no objection to including them as a part of the Corps of Engineers construction program provided state or local financial participation is not required.

"It is realized that the authorization document for the resurvey requires consideration of the Meramec Basin Corporation plan. If consideration must be given to including 'H' sites in your recommendations, it is requested that they be held to a minimum and that only 'H-6', 'H-13' and 'H-31' be retained."

g. Other agencies.

(1) St. Louis County Planning Commission. The St. Louis County Planning Commission has recommended for zoning as

open space for recreational usage some 14,000 acres in the Meramec River flood plain. It has made the following statement with respect to the proposed plan of improvement:

> "The St. Louis County Land Use Plan is based on projected needs of St. Louis County to the year 1980. The Corps of Engineers' planning is based on a 100-year analysis of need effective on a base year of 1970. The extreme difference in planning periods used by the two agencies results in the following: The Corps of Engineers' plan adds approximately 1100 acres of residential use, 1100 acres designated as urban use, and 1800 acres as industrial use, all in the present flood plains of the Meramec River. These areas would not be beneficially affected by any upstream flood water storage capacity until the completion of the dams proposed on the Meramec River and its tributaries. It appears reasonable that it will take fifteen years to develop and effect the flood control system necessary to provide the degree of flood reduction in St. Louis County contemplated in current Corps of Engineers' studies. Therefore, the existing flood plain situation, in regard to the approximate 4,000 acres projected for urban use by the Corps of Engineers, will probably continue to 1978 in any case. At the time when flood protection becomes a reality, land use designations would be reconsidered in relationship to the needs for land for specific urban uses."

(2) Meramec Basin Corporation. The Meramec Basin Corporation established cooperative committees to assist in coordination among Federal, State, and local groups. These committees are currently investigating local participation requirements, including exploration of the need for conservancy districts and zoning requirements. The Meramec Basin Corporation has submitted the following statement with respect to the proposed plan of improvement:

> "1) The Basin plan described in the U. S. Engineers' Synopsis of Findings of December 4, 1963, should be approved as the basis for the much needed program of long range care and development of water and related resources in the Meramec Basin.

"2) Action on the Basin plan should be phased for the immediate construction of at least 4 main stream reservoirs, 5 tributary stream reservoirs, and at least 5 headwater stream reservoirs.

"3) At the earliest possible date there should be developed those angler use sites that fit into the pattern of reservoirs chosen for initial construction.

"4) The levee system, and related features proposed, should be installed as soon as arrangements with local interests can be completed.

"5) In meeting the increasing demands of a growing population through the Basin plan, the detailed planning for actual development should give special attention to all possible insurance of the preservation and proper use of natural resources and unique scenic and man-made attractions.

"6) In the progress of the detailed planning for actual development, particular care should be exercised to safeguard the rights, and lessen the problems, of landowners and others affected by reservoirs, levees, and other proposed facilities.

"7) Continued and close cooperation between government agencies and people of the Basin should be maintained in light of the variety of responsibilities and participation that is implicit in the Basin plan with the interests involved of federal, state, and local government, local organizations, the public generally, and many individuals.

"8) The well being of the people of the Basin, the progress of its economy, and the proper care of its natural resources call for immediate and urgent action on the above recommendations."

(3) Mississippi Valley Association. Representatives of the Mississippi Valley Association have attended the coordination meetings and have expressed approval of the basin plan.

h. Views of local interests. Local interests have expressed general approval of the basin plan. For a digest of opinions received in the two public hearings see APPENDIX S.

68. COMMENTS BY THE DISTRICT ENGINEER

The District Engineer concurs in general with the views expressed in the preceding paragraph, with the following exceptions:

a. Reservoirs in Clark National Forest, Missouri. Reference is made to recommendations by the U. S. Forest Service, Bureau of Outdoor Recreation, and National Park Service regarding administration of all reservoir-associated lands within the national forest. The District Engineer expresses general concurrence with these views, provided that the Forest Service acquire adjacent lands between the reservoir boundaries and the Forest Service's present holdings, so that there will be continuous Federal ownership. If the Forest Service cannot acquire these additional lands, then the Corps will manage the reservoir lands. In any event, reservoir operations, including maintenance and operation of the dam and related structures, will remain under the jurisdiction of the Corps in order to assure downstream benefits.

b. Lands requested by Missouri State Park Board. The State Park Board requests all inundated State park land be replaced with land in fee title above the conservation pool or similar level. Lands requested by the State to replace State-owned areas flooded by reservoirs will be acquired by the Corps and made available to the State at no cost through lease arrangement. However, there is no known authority or authorized procedure for conveying fee title to the State for such lands. The State Park Board requests that consideration be given to withdrawing the policy of the Corps of Engineers of requiring an equal number of free campsites before a charge can be made for such sites on licensed areas. The District Engineer recognizes that it is the State Park Board's policy to charge for family tent campsites throughout the State park system, and furthermore recognizes general public acceptance and approval of this policy. However, such policy is not in agreement with current Corps regulations.

c. Opposition of U. S. Fish and Wildlife Service to Site 17. The District Engineer has noted the opposition expressed by the U. S. Fish and Wildlife Service to the Meramec Park Reservoir, but believes that the objections are outweighed by the following factors:

(1) Meramec Park is the key reservoir to the solution of the flood control and flow regulation problems in the basin, with allocated benefits of $785,700 annually.

(2) Data furnished by the U. S. Fish and Wildlife Service and used in this report assigned $729,600 of annual benefits to this reservoir for lake fishing use, which is by far the greatest benefit to reservoir-type fishing of any of the reservoirs in the system.

(3) It is true that about 40 miles of clear-flowing stream will be inundated at normal pool level. However, provision for low-flow augmentation and means of regulating temperature and oxygen content of downstream releases, together with proposed angler-use sites, will substantially improve 87.5 miles of fishing below the dam.

d. Views of State agencies regarding local participation in headwater reservoirs. The State agencies expressed concern over the difference in local participation requirements for headwater reservoirs proposed by the Corps of Engineers and those required under the Soil Conservation Service program. They also indicate possible harm resulting to future conservation programs as a result of this difference. The District Engineer concurs in the foregoing viewpoint and recognizes that:

(1) The headwater reservoirs proposed herein meet essentially the criteria for works of improvement under the Watershed Protection and Flood Prevention Act, Public Law 566, 83rd Congress, as amended.

(2) There is a need for closer agreement in local participation requirements.

Accordingly, the District Engineer proposes that the sponsoring local organizations for the headwater reservoirs assume the costs of lands, easements, and rights-of-way, including relocations and access roads for all works of improvement for purposes other than public fish and wildlife and recreational development, plus 50 percent of the cost allocated to recreation. To avoid any duplication, the share of joint-use costs for lands, easements, and rights-of-way, including relocations and access roads, distributed to recreation has been deleted from the total cost allocated to recreation. In addition, non-Federal interests would be required to assume the entire cost of operation and maintenance, including major replacements. There is shown in TABLE 60 apportionment of cost between Federal and non-Federal interests based on the foregoing requirements.

TABLE 60
Cost sharing - headwater reservoirs

Reservoir	Total project cost	Federal share		Non-Federal share - first cost						O&M annual cost*
		First cost	Percent	Lands, easements, & rights-of-way cost	Percent	Recreation cost	Percent	Total cost	Percent	
Dry Creek (H-3)	$ 419,000	$ 251,000	59.90	$ 102,000	24.35	$ 66,000	15.75	$ 168,000	40.10	$ 14,500
Joanne Course (H-4)	740,000	457,000	61.76	123,000	16.62	160,000	21.62	283,000	38.24	13,900
Brady Creek (H-5A)	362,000	213,000	58.84	86,000	23.76	63,000	17.40	149,000	41.16	13,500
Birch Creek (H-6)	830,000	502,000	60.48	166,000	20.00	162,000	19.52	328,000	39.52	18,300
Little Indian Creek (H-8)	1,020,000	628,000	61.57	237,000	23.23	155,000	15.20	392,000	38.43	17,900
Bates Creek (H-9)	566,000	386,000	68.20	105,000	18.55	75,000	13.25	180,000	31.80	10,000
Winsell Creek (H-11A)	379,000	192,000	50.66	124,000	32.72	63,000	16.62	187,000	49.34	15,600
Boone Creek (H-13A)	761,000	478,000	62.81	205,000	26.94	78,000	10.25	283,000	37.19	16,300
Big River (H-25)	571,000	321,000	56.22	132,000	23.12	118,000	20.66	250,000	43.78	9,600
Total	$5,648,000	$3,428,000		$1,280,000		$940,000		$2,220,000		$129,600

*Non-Federal cost.

SECTION XIV - LOCAL COOPERATION

69. LOCAL COOPERATION IN THE BASIN PLAN

a. Basic principles. The division of project costs between Federal and non-Federal interests is based on the allocation of costs to the project purposes and presently applicable laws and regulations governing cost-sharing practices.

b. Non-Federal responsibilities. In accordance with the Water Supply Act of 1958 and the Federal Water Pollution Control Act Amendments of 1961, all construction, operation and maintenance, replacement, and interest costs incurred by the Federal Government and allocated to water supply are to be repaid by the water users. No payment is required for the costs allocated to future water supply until such time as the project is first used for that purpose, except for the payment of interest charges on the unpaid balance after the interest free period, which shall not exceed 10 years. The construction costs, including interest during construction and interest on the unpaid balance, may be paid in a lump sum or in equal annual payments within the life of the project, but not to exceed 50 years after water supply use is initiated. In addition, annual payments must be made for the operation and maintenance costs allocated to water supply, beginning with the first use of storage for water supply, plus payment of applicable replacement costs when incurred. The above requirements are equally applicable to provisions for additional water supply and at such time that portions of reservoir storage are converted to meet long-term demands. Project costs allocated to recreation for the main stream and tributary stream reservoirs have been apportioned between Federal and non-Federal interests in accordance with the cost-sharing policy adopted by the Administration and outlined in H. R. 9032, 88th Congress. The extent to which local interests are required to cooperate financially in the main stream and tributary stream reservoirs is based on the estimated percentages shown under non-Federal costs in TABLES 54, 55, and 57, SECTION XII. Sponsors of the headwater reservoirs will be required to assume the costs of lands, easements, and rights-of-way, including relocations and access roads for all works of improvement for purposes other than public fish and wildlife and recreation development, plus 50 percent of the cost allocated to recreation. They will also be required to assume the entire cost of operation and maintenance, including major replacements. The estimated non-Federal share of the cost of the

headwater reservoirs is shown in TABLE 60, SECTION XIII. Reimbursement of costs for recreation may be made by lump sum payment prior to construction, payment during construction in amounts proportional to annual Federal construction costs, or payment over a period of 50 years after completion of the project, with interest during the repayment period. In addition to the foregoing, responsible local interests will be required to furnish assurances satisfactory to the Secretary of the Army that they will:

(1) For reservoirs:

(a) Undertake all practicable measures to control pollution of streams subject to low-flow augmentation by adequate treatment or other methods of controlling wastes at their source; protect channels downstream of the reservoirs from encroachment which would adversely affect operation of the reservoir system; and hold and save the United States free from all water rights claims resulting from construction, operation, and maintenance of these reservoirs.

(b) Protect project lands for certain reservoirs, as designated, by zoning or by acquisition of title to such lands as may be required to preserve the sites against incompatible development.

(2) For angler-use sites: Maintain and operate these developments after completion in accordance with regulations to be prescribed by the Secretary of the Army and hold and save the United States free from claims resulting from construction, operation, and maintenance of these sites.

(3) For local protection projects: Provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the projects; hold and save the United States free from damages due to the construction works; maintain and operate the projects after completion in accordance with the regulations prescribed by the Secretary of the Army; accomplish without expense to the United States alterations and relocations to all roads and utilities as may be required; construct necessary interior drainage ditches; and prevent encroachment on improved channels or ponding areas, and, if ponding areas and capacities are impaired, provide substitute storage or equivalent pumping capacity without cost to the United States.

c. Views of local interests. The terms of local cooperation were carefully explained to those in attendance at the public hearing held on 18 December 1963. With regard to local participation in project costs, the Governor's Advisory Committee on resurvey of the Meramec River Basin made the following comments:

> "At the present time there are no funds available to any of the Missouri State Agencies which can be used for the purpose of water supply storage in federal reservoirs. The Missouri Water Resources Board has been instructed by the Missouri legislature to investigate and to recommend a means whereby state and local obligations for water supply storage can be met. A plan will be presented to the 73rd General Assembly which will meet in January, 1965. However, reaction of the legislature and future legislatures to the proposal of the Water Resources Board can not be predicted and for this reason no assurance or the method of repayment can be made at this time.
>
> "Apportionment of project costs also requires non-federal contributions toward recreational benefits. At present there are no funds available for recreational development from the State of Missouri for participation in meeting projects costs. The need for the recreational facilities proposed in the Corps of Engineers report is recognized. However, as with water supply storage no firm assurance for state or local participation can be made at this time. Future participation would be dependent upon appropriations from general funds by the legislature."

The Meramec Basin Corporation, through its cooperative committee, is working with various local governments and local organizations in the development of regional plans for the basin. The Corporation is also cooperating with State and local agencies in determining the best plan for accomplishing the requirements of local participation in the basin plan.

SECTION XV - IMPLEMENTATION OF THE BASIN PLAN

70. GENERAL

The 7 main stream reservoirs, 12 tributary stream reservoirs, 12 headwater reservoirs, 26 angler-use sites, and 9 local protection levees included in the basin plan provide a proper scale of development in each of the sub-basins, and assure that the immediate and long-range water needs of the basin as a whole can be met. The basin plan will provide:

a. Flood control approximately equal to standard project flood protection in the lower basin, with a practical degree of protection in the upper basin against floods having a frequency of occurrence varying from 2 to 10 percent.

b. All of the required water quality control needs both in the upper and lower basin.

c. All supplemental water supply requirements.

d. Recreation and fish and wildlife developments to meet the immediate and future needs to the fullest practicable extent.

e. Improvement of economic conditions in the upper basin area.

71. SCHEDULE FOR PROJECT DEVELOPMENTS

The selection of the time sequence and order of development for the various elements in the basin plan are based on the projected time patterns of water resource demands. While projected demands are based on the best information currently available, it is recognized that their dependability and accuracy lessen with the length of the period of projection. After completion of construction of each phase of development, definition of needs should be re-examined before continuing with the next phase of development. Such re-examination could result in some modification in the use of projects previously constructed as well as in improvements planned for subsequent construction. Present proposals for initial Federal participation are limited to those elements

of the basin plan that current and projected needs indicate should be constructed in the next 10 to 15 years. To meet the immediate and long-range water needs of the basin, the following order of construction is proposed:

a. Initial construction within the next 10 to 15 years of those improvements which are economically justified and for which there is an imminent need.

b. Later construction of those improvements which are economically justified and for which there is a foreseeable future need.

c. Deferred construction of those improvements which currently lack economic justification based on present-day evaluations.

72. PHASE I CONSTRUCTION

a. Reservoirs. Reservoirs proposed for initial construction are shown on FIGURE 25 and include Pine Ford, Irondale, Meramec Park, Union, I-26, I-28, I-38, H-3, H-5A, H-8, H-9, H-13A, and H-25. These have been selected for the following reasons:

(1) The three main stream reservoirs, Pine Ford, Meramec Park, and Union, will afford immediate protection to the flood plains along the 182.5 miles of streams in lower Big, Bourbeuse, and Meramec River valleys where present flood damages are greatest. Construction of the local protection projects in the lower basin is also contingent upon reduction of flood stages by these three reservoirs which together control 77 percent of the entire drainage area of the basin.

(2) They will provide 22,900 acres of water surface area for recreation use close to St. Louis, being within 45 minutes to 1-1/2 hours driving time.

(3) The Irondale reservoir will satisfy present needs for water quality control for the upper Big River, alleviate flood damages on the 50 miles of Big River Valley above the Pine Ford Reservoir, and provide much-needed relief to the depressed economy of the upper basin area.

(4) The three tributary stream reservoirs will meet the immediate needs for flood control, water quality control, recreation, and area redevelopment. Reservoir I-26 has been recommended for early construction by the U. S. Forest Service as a vital part of the program for development of the recreation resources of the Clark National Forest.

(5) All six of the headwater reservoirs would provide upstream flood control, recreation opportunities, and area reorientation benefits. Reservoir H-3 will protect the town of Ware from flood damages and has received a high priority of construction indorsement by Jefferson County officials.

(6) These reservoirs represent the best consensus of views of the participating agencies and of the public.

b. Angler-use sites. Twenty-one angler-use sites below the aforementioned reservoirs are proposed for construction to provide for increased use of the streams by float fishermen and hunters. These sites are shown on FIGURE 25.

c. Local protection. Local protection levees proposed for construction are shown on FIGURE 26 and include Starling Airport, West Watson Road, Weiss Airport, Valley Park, and Peerless Park. Protection would permit change in land use to a higher level of development to meet the growing demand for residential and industrial areas.

73. PHASE II CONSTRUCTION

a. Reservoirs. Following completion of Phase I construction, the remainder of the reservoirs currently found justified should be re-examined to determine if the projected needs are still valid and justification exists on which to base a recommendation for authorization at that time. These reservoirs are Washington Park, Virginia Mines, Salem, I-33A, I-35A, H-4, H-6, and H-11A.

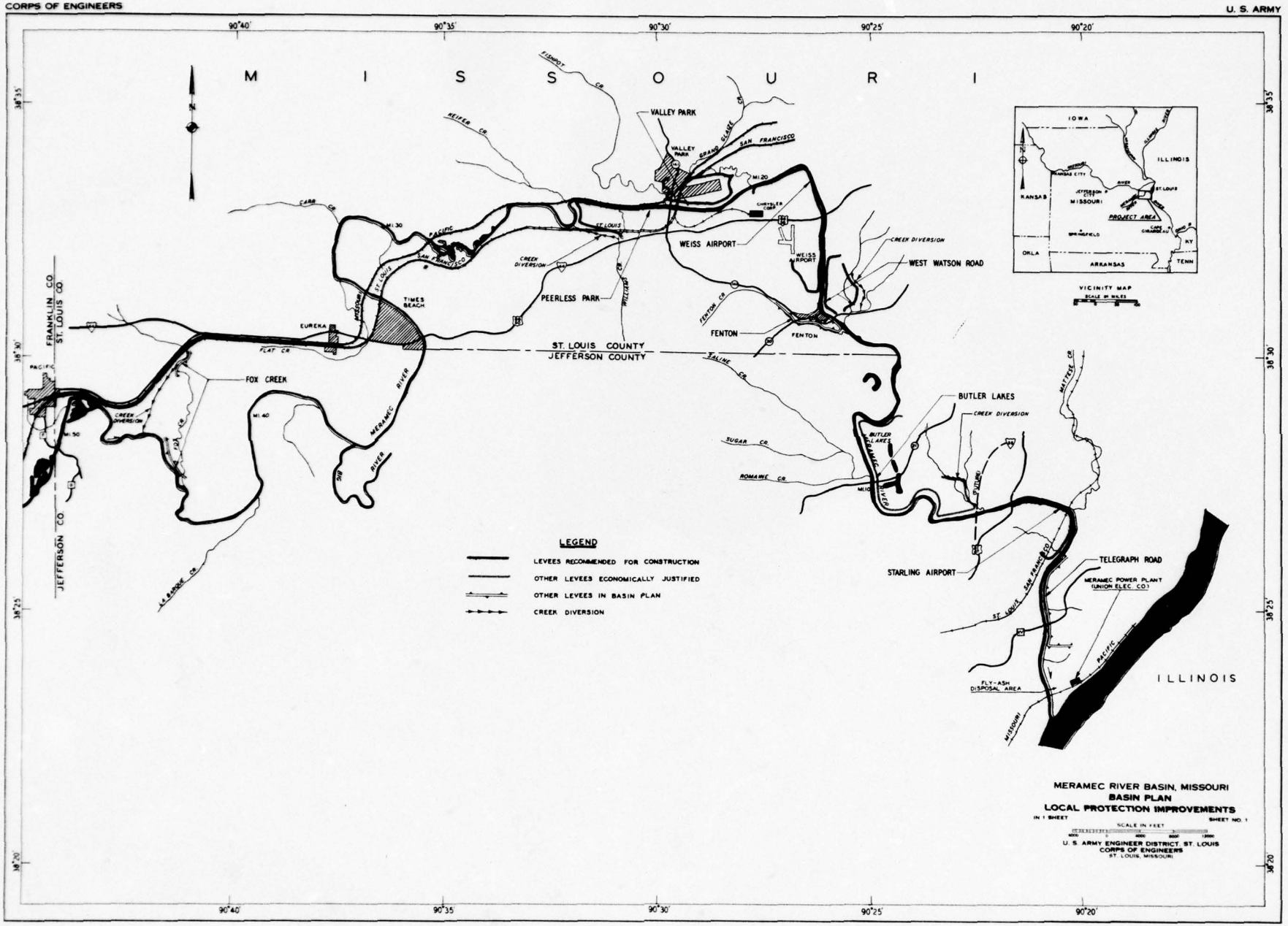
b. Angler-use sites. Three angler-use sites below the Salem Dam would be constructed in this phase to meet the needs of float fishermen.

MERAMEC RIVER, MISSOURI
BASIN PLAN

FIGURE 25

CORPS OF ENGINEERS

U. S. ARMY



MERAMEC RIVER BASIN, MISSOURI
BASIN PLAN
LOCAL PROTECTION IMPROVEMENTS
IN 1 SHEET
SHEET NO. 1
SCALE IN FEET
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

202b

FIGURE 26

c. Local protection. The Butler Lakes area, which presently shows economic justification but was deferred because of local opposition, should be re-examined to determine whether any changed conditions would warrant construction at that time and whether all or part of the area should be protected.

74. PHASE III CONSTRUCTION

After completion of improvements of Phase II construction, the remaining components in the basin plan should be re-examined to determine their need and economic justification.

a. Reservoirs. The remaining reservoirs, I-14, I-15A, I-21, I-23, I-30, I-32, I-41, H-10A, H-31, and H-40, would be re-evaluated and recommended for authorization and construction if economically justified at the time.

b. Angler-use sites. The remaining two angler-use sites below I-15A would be re-evaluated and constructed if I-15A was found to be economically justified.

c. Local protection. The remaining three local protection levees, Telegraph Road, Fenton, and Fox Creek, would be reanalyzed to determine their need and economic justification.

75. CONSTRUCTION SCHEDULE

There are shown in TABLE 61 the estimated Federal and non-Federal costs for each phase of construction and in TABLE 62 a schedule of fund requirements by years for planning and construction of Phase I improvements.

TABLE 61
Construction schedule

(in thousands of dollars)

Reservoirs		Reservoirs: Federal	Reservoirs: Non-Federal	Reservoirs: Total	Angler-use sites: No. of sites below reservoir	Angler-use sites: Federal first cost	Local protection: Area protected		Local protection: Federal	Local protection: Non-Federal	Local protection: Total
Improvements recommended for construction within next 10-15 years (Phase I)											
Pine Ford	(2A)	$ 23,789	$ 411	$ 24,200	5	$134					
Irondale	(9)	12,978	522	13,500	4	117					
Meramec Park	(17)	36,454	1,246	37,700	3	84					
Union	(29)	20,155	5,445	25,600	4	117					
West Fork Huzzah Creek	(I-26)	4,108	172	4,280	2	50					
Spring Creek	(I-28)	4,611	169	4,780	3	84					
Bourbeuse River	(I-38)	5,399	211	5,610	-	--					
Dry Creek	(H-3)	251	168	419	-	--					
Brady Creek	(H-5A)	213	149	362	-	--	Starling Airport	(No. 4)	$2,350	$ 378	$2,728
Little Indian Creek	(H-8)	628	392	1,020	-	--	W. Watson Road	(No. 8)	698	193	891
Bates Creek	(H-9)	386	180	566	-	--	Weiss Airport	(No. 9)	1,430	220	1,650
Boone Creek	(H-13A)	478	283	761	-	--	Valley Park	(No. 11)	1,350	289	1,639
Big River	(H-25)	321	250	571			Peerless Park	(No. 12)	1,910	383	2,293
Phase I totals		$109,771	$9,598	$119,369	21	$586			$7,738	$1,463	$9,201
Other improvements economically justified (Phase II)											
Washington Park	(5)	$ 14,792	$2,008	$ 16,800	-	--					
Virginia Mines	(40)	15,190	3,210	18,400	-	--					
Salem	(27)	14,459	441	14,900	3	$ 84					
Little Bourbeuse River	(I-33A)	4,809	341	5,150	-	--					
Brush Creek	(I-35A)	4,922	278	5,200	-	--					
Cabanne Course	(H-4)	457	283	740	-	--					
Birch Creek	(H-6)	502	328	830	-	--					
Winsell Creek	(H-11A)	192	187	379	-	--	Butler Lakes	(No. 5)	$3,230	$ 339	$3,569
Phase II totals		$ 55,323	$7,076	$ 62,399	3	$ 84			$3,230	$ 339	$3,569
Improvements in basin plan for future re-evaluation (Phase III)											
Huzzah Creek	(I-14)	*	*	$ 6,640	-	--					
Courtois Creek	(I-15A)	*	*	6,950	2	$ 50					
Peavine Creek	(I-21)	*	*	3,440	-	--					
Little Dry Fork Creek	(I-23)	*	*	4,870	-	--					
Terre Bleue Creek	(I-30)	*	*	3,540	-	--					
Redoak Creek	(I-32)	*	*	4,410	-	--					
Benton Creek	(I-41)	*	*	3,680	-	--					
Lost Creek	(H-10A)	*	*	488	-	--	Telegraph Road	(No. 2)	$2,280	$ 237	$2,517
Dry Fork Creek	(H-31)	*	*	530	-	--	Fenton	(No. 7)	1,220	674	1,894
Coonville Creek	(H-40)	*	*	504	-	--	Fox Creek	(No. 17)	1,300	207	1,507
Phase III totals		---	---	$ 35,052	2	$ 50			$4,800	$1,118	$5,918

*Federal and non-Federal breakdown not available.

TABLE 62
Schedule of fund requirements - phase I construction ($1,000)

Reservoir	Year 1	2	3	4	5	6	7	8	9	10	11	12	Total cost
17 Meramec Park	($300)	($ 500)	($ 400)	$4,000	$ 8,100	$ 8,200	$ 8,200	$ 8,000					$ 37,700
29 Union		(400)	(400)	(200)	4,100	7,700	7,700	5,100					25,600
I-26 West Fork Huzzah Creek		(200)	(200)	700	1,600	1,580							4,280
I-38 Bourbeuse River			(200)	(200)	1,100	2,100	2,010						5,610
2A Pine Ford				(300)	(300)	(200)	3,000	7,600	7,600	$ 5,200			24,200
9 Irondale					(200)	(200)	(200)	2,000	3,900	4,000	$ 3,000		13,500
H-25 Big River					(50)	(25)	200	296					571
H-9 Bates Creek					(50)	(30)	200	286					566
H-8 Little Indian Creek						(100)	(50)	400	470				1,020
I-28 Spring Creek							(200)	(200)	900	1,700	1,780		4,780
H-13A Boone Creek							(50)	(40)	311	360			761
H-3 Dry Creek								(25)	(20)	170	204		419
H-5A Brady Creek									(30)	(20)	130	$ 182	362
Subtotal, reservoirs	$300	$1,100	$1,200	$5,400	$15,500	$20,135	$21,810	$23,947	$13,231	$11,450	$ 5,114	$ 182	$119,369
Local protection													
11 Valley Park								(80)	(60)	749	750		1,639
4 Starling Airport								(130)	(120)	1,210	1,268		2,728
9 Weiss Airport								(90)	(70)	740	750		1,650
12 Peerless Park									(110)	(100)	1,035	1,048	2,293
8 West Watson Road									(40)	(30)	400	421	891
Subtotal, local protection								$ 300	$ 400	$ 2,829	$ 4,203	$1,469	$ 9,201
Angler-use sites						(45)	50	84	117	117	173		586
Grand total	$300	$1,100	$1,200	$5,400	$15,500	$20,180	$21,860	$24,331	$13,748	$14,396	$ 9,490	$1,651	$129,156

Year 1 is the fiscal year following project authorization.

( ) Preconstruction planning.

SECTION XVI - DISCUSSION

76. GENERAL

The Meramec River Basin, while rich in natural resources, is one of the least developed areas in the nation. Except for that portion which lies within the Metropolitan St. Louis area, much of the basin's economy verges on semi-depressed. The population of the Meramec River Basin, which was 212, 000 in 1960, is projected to 640, 000 in 2000, 1, 000, 000 in the year 2020, and 3, 000, 000 by 2070. Much of this anticipated population increase will come from the future expansion of the St. Louis Metropolitan area. Essential to this growth will be the development of water and related land resources to meet the demands for:

a. Adequate supply of water for domestic, municipal, and industrial uses.

b. Water quality facilities and controls to assure water of suitable quality for all purposes.

c. Flood control or prevention measures to protect people, property, and productive lands from flood losses.

d. Regulation of the use and development of flood plains.

e. Hydroelectric power where its provision can contribute advantageously to needed increases in power supply.

f. Outdoor recreation and fish and wildlife conservation.

g. Land management and conservation including watershed protection measures.

77. PROBLEMS

Flow of the Meramec River in its present condition is extremely variable - insufficient during dry summer periods and destructive at other times. The Meramec River and its tributary system have sufficient water generally to meet the present and future needs, provided the water can be made available in the right quantities, of the right quality, at the right times and in the right places. Based on

the projected population growth, a rising standard of living, and an anticipated increase in industrial and commercial developments, available ground and surface water resources will provide anticipated water demands up to about the year 1995. Beyond this date, other sources will need to be developed. The natural streams can satisfy the projected requirements for water quality to the year 1970, and then, even with adequate source treatment, deficiencies will develop in the lower basin beginning in 1990 and will become basinwide by the year 2020. Floods in the Meramec Basin have occurred in all seasons of the year. Thousands of cultivated acres in the flood plain and portions of the towns of Valley Park, Pacific, Fenton, Times Beach, Glencoe, and Cedar Hill are subject to flooding, causing an average annual damage currently estimated at $1,903,000. Provision of measures for flood control will bring about a demand for additional lands to meet the need for future urban and industrial developments in the lower part of the basin. Projected needs of power supply indicate that a definite need will exist for peaking capacity within the area by 1970 when approximately 490 megawatts at 10 percent load factor will be required in the power supply area and 675 megawatts at 10 percent load factor by 1980. A growing population with greater personal income, more leisure time, increased mobility, and living in a rapidly expanding urban environment will place greater demands on the use of the outdoors for recreation, including hunting and fishing. Existing facilities in the basin can support approximately 3,900,000 visitor-days annually. By the year 1970, projected demands will amount to 9,500,000 visitor-days. Associated with the economic problems are the persistent unemployment and underemployment which currently prevail in seven counties which lie wholly or partly within the Meramec River Basin.

78. SOLUTIONS CONSIDERED

Several possible solutions were considered for each type of need, including groundwater and surface water development and diversion from other basins for water supply; primary and secondary waste treatment, lagooning, and dilution for water quality control; flood storage, local protection, and flood plain zoning for flood control; conventional and pumped storage for hydroelectric power development; and single-purpose and multiple-purpose developments for recreation, including the recreational aspects

of fish and wildlife. Where long-range water needs were foreseeable only in general terms and where alternative means of meeting these needs were not available, consideration has been given to inclusion of additional capacity initially in reservoirs where it could be accomplished at a significant savings over subsequent enlargement. Likewise, consideration was given to change in storage allocations to meet needs at selected points of time. After careful consideration of all alternatives, it was concluded that the best plan for meeting the water needs of the Meramec River Basin would be one which included the following features:

a. Reservoir storage for regulation of the dependable flows for water supply and water quality control.

b. Reservoir storage for flood control.

c. Local flood protection.

d. Programs for controlling and regulating the use and development of flood plains where other means for flood prevention are not economically feasible.

e. Reservoir and auxiliary storage for hydroelectric power generation.

f. Development of the recreational potential of project lands and waters.

g. Continuation and expansion of land management and conservation practices.

79. BASIN PLAN

The plan which will provide the best use or combination of uses for water and related land resources to meet all foreseeable short- and long-term needs in the basin consists of 7 main stream reservoirs, 12 tributary stream reservoirs, 12 headwater reservoirs, 26 angler-use sites, and 9 local protection levees. This plan will provide for: generally all water supply needs to the year 2070; water quality control through stream flow augmentation to the year 2070; elimination of about 75 percent of the current flood damages in the basin and reduction in flood crests on the Mississippi River;

protection to approximately 3,600 acres of lands needed for future urban and industrial expansion; recreational opportunities, including hunting and fishing, for approximately 18,000,000 visitor-days annually by the year 2020 and nearly 28,000,000 visitor-days ultimately; and reorientation of the depressed economy of the basin. While development of hydroelectric power is not currently feasible because it cannot be produced at an acceptable cost and desirable load factor, it is retained in the basin plan for future consideration at such time as economic conditions warrant. The plan is flexible and provides for extension of services as they become necessary and justified in the future. The comprehensive plan of development meets with general public approval. Additional information on the improvements contained in the basin plan called for by Senate Resolution 148, 85th Congress, 1st Session, is contained in ATTACHMENT 1 to this report.

80. INITIAL IMPROVEMENTS

In determining improvements to be recommended for authorization and construction in the near future, full consideration has been given to the views of all Federal, State, and local agencies, including the Meramec Basin Corporation, which participated in the study. In arriving at the selection of improvements to be recommended at this time, certain criteria or guidelines were used; i.e., individual projects and project purposes must be economically justified and the project is required to fulfill presently urgent needs of the basin. All of the main stream reservoirs and angler-use sites were found to be economically justified. Only 5 of the 12 tributary stream reservoirs and 9 of the 12 headwater reservoirs met the criteria of over-all justification and justification of project purposes. Six of the nine levee projects were found to be justified. Imminent needs of the basin are water quality control, flood control, recreation, fish and wildlife conservation, and assistance to economically depressed areas. While water supply storage generally is a long-term need, storage has been provided initially in most of the reservoirs which will afford beneficial use for recreation and fish and wildlife conservation during the interim period as well as afterwards. To meet these immediate and near future needs, the following improvements are selected for early construction:

a. Four of the main stream reservoirs, designated as Pine Ford, Irondale, Meramec Park, and Union.

b. Three of the tributary stream reservoirs, designated as I-26, I-28, and I-38.

c. Six of the headwater reservoirs, designated as H-3, H-5A, H-8, H-9, H-13A, and H-25.

d. Twenty-one of the angler-use sites.

e. Five of the local protection projects, designated as areas Nos. 4, 8, 9, 11, and 12.

The need for and selection of the above improvements for construction are, in general, concurred in by the majority of agencies, including the State and the Meramec Basin Corporation. The Soil Conservation Service, however, indicates that it cannot recommend projects for authorization at this time pending completion of its current study. The cost of the initial improvements in the basin plan is estimated at approximately $129,156,000, of which $118,095,000 would be Federal cost and $11,061,000 non-Federal cost. Federal and non-Federal participation is in accordance with applicable laws, regulations, and Administration policy governing cost-sharing practices. Operation and maintenance of the angler-use sites will be the responsibility of an appropriate non-Federal agency. The State of Missouri has demonstrated sufficient interest and approval in the basin plan to warrant the assumption at this time that necessary local cooperation would be forthcoming.

SECTION XVII - CONCLUSIONS

81. CONCLUSIONS

Based on the foregoing analysis, it is concluded that:

a. The basin plan, consisting of seven main stream reservoirs, 12 tributary stream reservoirs, 12 headwater reservoirs, 26 angler-use sites, and nine local protection projects, would provide the best use or combination of uses of water and related land resources to meet all foreseeable short- and long-term needs in the Meramec River Basin.

b. Four of the main stream reservoirs, designated as Pine Ford and Irondale, both on Big River, Meramec Park on Meramec River, and Union on Bourbeuse River; three of the tributary stream reservoirs, designated as I-26 on West Fork Huzzah Creek, I-28 on Spring Creek, and I-38 on Bourbeuse River; six of the headwater reservoirs, designated as H-3 on Dry Creek, H-5A on Brady Creek, H-8 on Little Indian Creek, H-9 on Bates Creek, H-13A on Boone Creek, and H-25 on Big River; 21 of the angler-use sites; and five of the local protection projects, designated as areas Nos. 4, 8, 9, 11, and 12, should be authorized and constructed within the next 10 to 15 years to meet immediate needs for flood control, water quality control, recreation, fish and wildlife conservation, and area redevelopment.

c. Local participation, as outlined in SECTION XIV, is warranted in view of the water supply and recreational benefits the projects would provide.

d. Non-Federal interests have demonstrated sufficient interest and approval of the basin plan to warrant the assumption at this time that the necessary local cooperation would be forthcoming.

e. Appropriate measures should be taken to preserve reservoir sites against incompatible developments.

f. While hydroelectric power for peaking purposes is not marketable at the present time, it should be retained in the basin plan for further consideration at such time as warranted.

SECTION XVIII - RECOMMENDATIONS

82. RECOMMENDATIONS

The District Engineer recommends:

a. That the plan generally as formulated in this report be adopted as the comprehensive plan for development and beneficial uses of the water resources of the Meramec River Basin. The plan includes:

(1) Seven main stream reservoirs, 12 tributary stream reservoirs, and 12 headwater reservoirs, as listed and for the purposes shown in TABLES 43, 44, and 45, at a total estimated cost of $216,820,000.

(2) Nine local flood protection projects for urban and industrial areas, at a total estimated cost of $18,688,000.

(3) Twenty-six angler-use sites to provide needed access and stopover points for float fishing, as recommended by the U. S. Fish and Wildlife Service, at a total estimated cost of $720,000.

(4) Further consideration of the hydropower potential at the main stream reservoirs at such time as the need for, and the marketability of, power warrant such provision.

b. That four of the main stream reservoirs, designated as Pine Ford, Irondale, Meramec Park, and Union; three of the tributary stream reservoirs, designated as I-26, I-28, and I-38; six of the headwater reservoirs, designated as H-3, H-5A, H-8, H-9, H-13A, and H-25; 21 of the angler-use sites downstream of the applicable aforementioned reservoirs; and five of the local protection projects, designated as areas Nos. 4, 8, 9, 11, and 12, be authorized for construction for the purposes of flood control, water supply, water quality control, fish and wildlife conservation, recreation, and area redevelopment, as applicable, generally in accordance with the comprehensive plan and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at a total estimated cost of $129,156,000, of which $118,095,000 would be Federal cost and $11,061,000 non-Federal cost, which includes reimbursable costs amounting to $8,731,000 for water supply and recreation. Annual costs

for maintenance, operation, and major replacements are estimated at $1,738,000, of which $1,425,500 would be Federal costs and $312,500 non-Federal costs.

c. That, immediately following authorization of the reservoirs and angler-use sites listed in b above, sufficient site investigations and designs be made for the purpose of defining the project lands required, and that, subsequently, advance acquisition be made of such title to such lands as may be required to preserve the sites against incompatible developments.

d. That, prior to construction of each of the main stream and tributary stream reservoirs, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Repay the costs allocated to water supply, as determined by the Chief of Engineers, in accordance with the provisions of the Water Supply Act of 1958, as amended by the Federal Water Pollution Control Act Amendments of 1961. Such costs will be determined by applying the percentages given in TABLE 57 for reservoirs listed in b above to actual costs for initial construction, operation, maintenance, and major replacements. Cost of water supply storage to meet needs over the first 50 years of the period of analysis is presently estimated at $2,483,000 for construction and $24,800 annually for maintenance, operation, and major replacements. Cost of water supply from conversion of storage to meet the needs covering the last 50 years of the period of analysis is presently estimated at $5,590,000 for construction and $43,700 annually for maintenance, operation, and major replacements.

(2) Repay that portion of the construction costs allocated to recreation, including the recreational aspects of fish and wildlife, in accordance with the cost-sharing policy outlined in H. R. 9032, 88th Congress. Such costs will be determined by applying the percentages given in TABLES 54 and 55 to actual costs for construction, presently estimated for those reservoirs listed in b above at $103,000.

e. That, prior to construction of each of the headwater reservoirs, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way, including relocations and access roads for all works of improvement for purposes other than public fish and wildlife and recreational development.

(2) Repay 50 percent of the construction costs allocated to recreation, including the recreational aspects of fish and wildlife. Such costs will be determined by applying the percentages given in TABLE 60 to actual costs for construction, presently estimated for those reservoirs listed in b above at $555,000.

(3) Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of the Army or in lieu thereof pay the annual costs of maintenance, operation, and major replacements, currently estimated for the reservoirs listed in b above at $81,800 annually.

f. That, prior to construction of each of the reservoirs listed in b above, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Undertake all practicable measures to control pollution of the streams subject to low-flow augmentation by adequate treatment or other methods of controlling wastes at their source.

(2) Protect channels downstream of the reservoirs from encroachment which would adversely affect operation of the reservoirs.

(3) Hold and save the United States free from all water rights claims resulting from construction, operation, and maintenance of the reservoirs.

g. That non-Federal interests be given the option to reimburse the United States for the portion of first costs of each reservoir, other than water supply, for which they are responsible, by:

(1) Payment in lump sum prior to construction.

(2) Payment during construction in amounts proportional to annual Federal construction costs, or

(3) Payment over a period of 50 years after completion of the project, with interest during the repayment period.

h. That, prior to construction of each angler-use site listed in b above, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Maintain and operate the site after completion in accordance with regulations to be prescribed by the Secretary of the Army.

(2) Hold and save the United States free from claims resulting from construction, operation, and maintenance.

i. That, prior to construction of each of the local protection projects, responsible non-Federal interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the projects; provide necessary relocations and alterations to highways, roads, and bridges; relocate and adjust all utilities; and construct necessary interior drainage ditches.

(2) Hold and save the United States free from damages due to the construction works.

(3) Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of the Army.

(4) Prevent encroachment on improved channels and ponding areas, and, if ponding areas and capacities are impaired, provide substitute storage capacity or equivalent pumping capacity promptly without cost to the United States.

j. That the reservoirs in the comprehensive plan designated as Washington Park, Virginia Mines, Salem, I-33A, and I-35A be authorized for site preservation, and that sufficient site investigations and designs be made for the purpose of defining the general project lands required, provided that responsible non-Federal interests give

assurances acceptable to the Secretary of the Army that they will protect such lands by zoning or by the acquisition of such title to such lands as may be required to preserve the sites against incompatible developments.

k. That the general comprehensive plan for flood control and other purposes in the upper Mississippi River Basin, approved by the Flood Control Act of 28 June 1938, be modified by deleting therefrom the reservoirs in the Meramec River Basin.

Inclosures listed
on page 217

JAMES B. MEANOR, JR.
Colonel, CE
District Engineer

7 Incl

1. Vol II -
   App A, Economy and Character of the Basin
2. Vol III -
   App B, Water Needs and Problems
3. Vol IV -
   App C, Hydrology
   App D, Geology, Soils, and Materials
4. Vol V -
   App E, Project Designs and Cost Estimates
   App F, Hydropower
5. Vol VI -
   App G, (Part 1) Physical Land Condition
   (Part 2) Design and Cost Estimates for Headwater Reservoirs
   App H, Plan of Participation by U. S. Department of Agriculture
   App I, Report on Forest Resource Potential
   App J, Mineral Resources and Mineral Industry
   App K, Groundwater Use and Production Capabilities
   App L, Water Resources Study
6. Vol VII -
   App M, Recreation Needs Related to Reservoirs
   App N, Multiple Use Survey
   App O, Effect on Fish and Wildlife
   App P, Effect on Caves
   App Q, Flood Control Economics
   App R, Evaluation of Benefits
   App S, Digest of Public Opinion
7. Vol VIII -
   App T, Detailed Cost Estimates

LMVGN (SLD rpt 30 Jan 64) 1st Ind
SUBJECT: Meramec River, Missouri - Comprehensive Basin Study

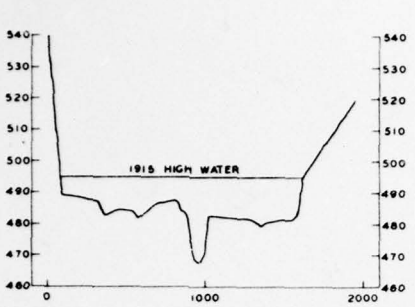
U. S. Army Engr Div, Lower Mississippi Valley, Vicksburg, Miss., 17 Apr 64

TO: Chief of Engineers

I concur in the findings and recommendations of the District Engineer.

7 Incl
nc

ELLSWORTH I. DAVIS
Major General, USA
Division Engineer



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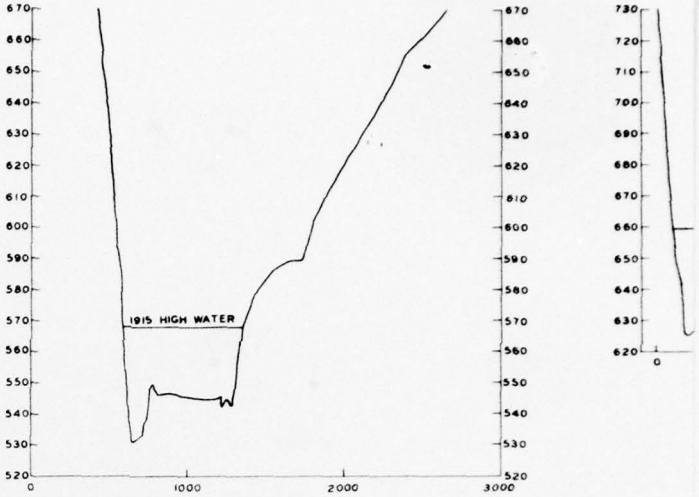
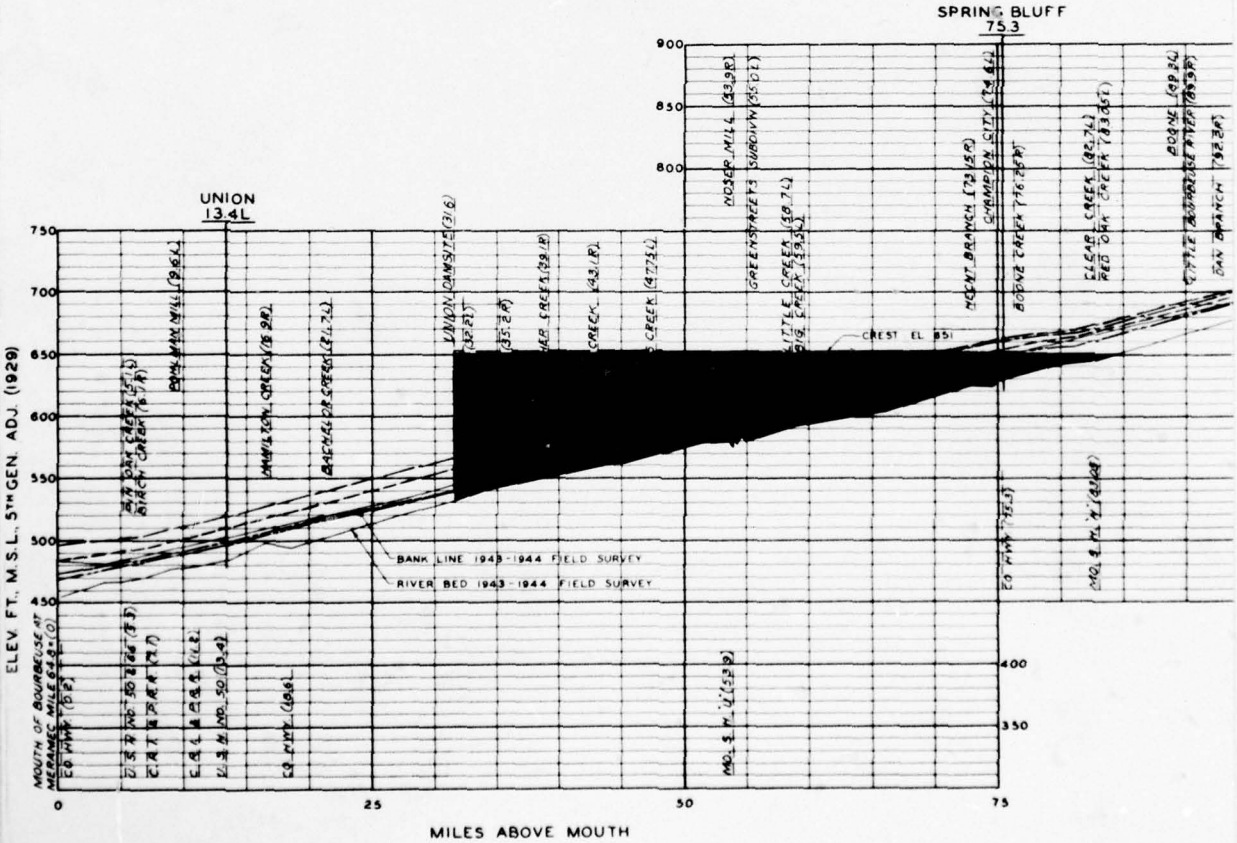
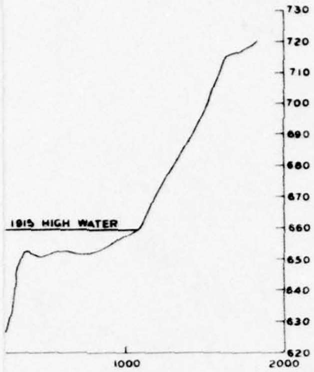


MILE 31.6
UNION DAM SITE

VALLEY CROSS SECTIONS
LOOKING DOWNSTREAM
HORIZONTAL SCALE IN FEET
1000 0 1000 2000

(ELEVATIONS REFERRED TO M.S.L. 5TH GEN. ADJ. 1929)





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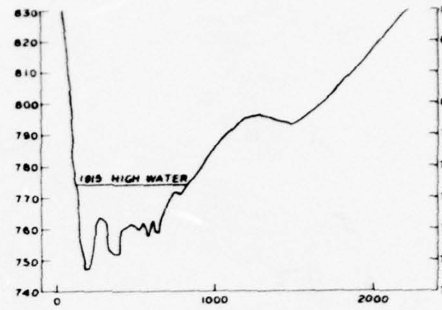

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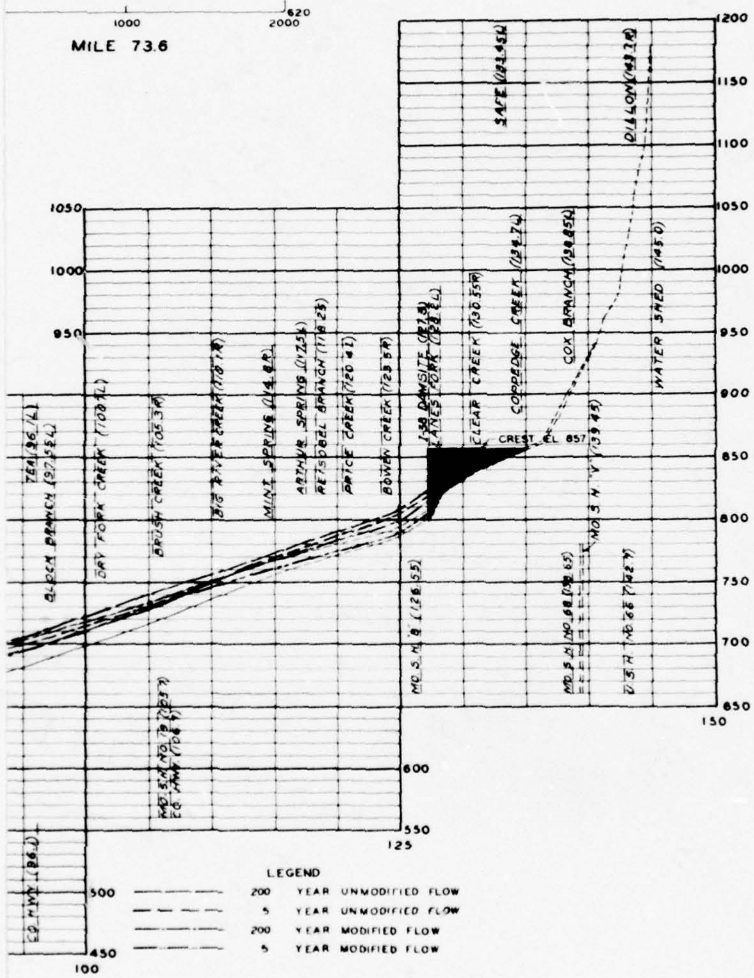


NOTES

Data relating to the location of towns, Federal, state and county highway bridges, springs and tributaries were secured from U.S. Geological Survey maps and from county highway maps prepared by the Missouri State Highway Department. Gage locations were obtained from the records of the Missouri Geological Survey and Water Resources and the U.S. Weather Bureau.

Bank and river bed profiles from the mouth to mile 112.7 are based on field data secured by survey parties under the direction of this office. The portions of the profiles between mile 112.7 and the source of the stream, indicated by dashed lines, represent information secured from maps but not checked by field surveys.

The designations R and L applied to locations refer to right or left bank looking downstream.

The abbreviation Mo. S.H. indicates ownership of bridge by Missouri State Highway Department.

Stream gage locations are written horizontally above the profile.

MERAMEC RIVER BASIN, MISSOURI
BOURBEUSE RIVER
PROFILE

IN 1 SHEET — SHEET NO. 1

SCALE AS SHOWN

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
JANUARY 1964

SUBMITTED	RECOMMENDED	APPROVED
HEAD, [illegible] SECTION	CHIEF, ENGINEERING DIVISION	COL., CORPS OF ENGINEERS, DISTRICT ENGINEER
DRAWN BY J.S.	TRANSMITTED WITH REPORT	FILE NO.
CHECKED BY C.A.M.	DATED	

MERAMEC RIVER, MISSOURI
COMPREHENSIVE BASIN STUDY

Information called for by
Senate Resolution 148, 85th Congress
adopted 28 January 1958

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

Attachment 1

SECTION I - BASIN PLAN

1. BASIN PLAN

The plan, developed to meet the short- and long-range needs of the basin, includes 7 main stream reservoirs, 12 tributary stream reservoirs, 12 headwater reservoirs, 26 angler-use sites, and 9 local protection levees. The plan contains the following features:

a. Reservoir storage for regulation of the dependable flows for water supply and water quality control.

b. Reservoir storage for flood control.

c. Local flood protection.

d. Programs for controlling and regulating the use and development of flood plains where other means for flood prevention are not economically feasible.

e. Development of the recreation potential of project lands and waters.

f. Assistance in reorientation of the upper basin's economy.

2. IMPLEMENTATION OF THE BASIN PLAN

Initial Federal participation is limited to those elements in the basin plan that current and projected needs indicate should be constructed at this time. These components of the basin plan include 4 main stream reservoirs, Pine Ford, Irondale, Meramec Park, and Union; 3 tributary stream reservoirs, I-26, I-28, and I-38; 6 headwater reservoirs, H-3, H-5A, H-8, H-9, H-13A, and H-25; 21 angler-use sites; and 5 local protection levees for the Starling Airport, West Watson Road, Weiss Airport, Valley Park, and Peerless Park areas. In selecting these improvements, full consideration has been given to the views of all Federal, State, and local agencies.

SECTION II - ECONOMIC FEASIBILITY

3. ESTIMATES OF FIRST COSTS

a. Reservoirs. Estimates of first costs of reservoirs are based on the assumption by the United States of all costs of the construction of the dams and appurtenant works; acquisition of lands and rights-of-way; alterations and relocations of highways, railroads, and utilities; and other remedial measures as necessary. Total project construction costs are summarized in TABLE 1 and are presented in detail in APPENDIX T.

b. Levees. Estimates of first costs for levee projects are based on the assumption that the Federal Government would construct the levees, drainage outlets, closure structures, pumping plants, access roads on top of levee, and railroad alterations as required. Non-Federal interests would furnish all lands, easements, and rights-of-way; bear all property damage costs; provide the necessary interior drainage ditches, except the main ditches at the pumping plants; and bear all costs for relocations of roads and utilities. Total levee project construction costs are summarized in TABLE 2 and are presented in detail in APPENDIX T.

c. Angler-use sites. Estimates of first costs for the angler-use sites are based on the assumption by the Federal Government of all construction costs of the required developments and the acquisition of lands and rights-of-way. Total project construction costs for angler-use sites are summarized in TABLE 3 and are presented in detail in APPENDIX T.

4. BENEFITS

The principal benefits attributable to the basin plan include reduction of flood damages in the Meramec River flood plain, reduction of flood crests in the Mississippi River, municipal and industrial water supply, low-flow augmentation in the interest of water quality control, general recreation, fish and wildlife conservation, and improvement in the basin economy associated with construction and operation of the reservoirs. An analysis was made of the basin's growth and needs for a 100-year period, with 1970 as a base year. Benefits expected to accrue at varying rates in the future were discounted to the base year and distributed as an equivalent uniform annual value over the period of economic analysis. Details of benefit evaluation and allocation of benefits to individual projects are contained in APPENDIX R.

5. BENEFIT-COST RATIO

Based on the foregoing, the benefit-cost ratios have been determined for those improvements recommended for authorization and construction. Selection of the economic life is dependent upon the type of project under consideration - 100 years for all reservoirs; 50 years for all angler-use sites; and a variable economic life, either 50 years or 100 years, for the levee projects, dependent upon the degree of flood protection provided. Benefit-cost ratios for the 13 reservoirs are shown in TABLE 4. Benefit-cost ratios for the 5 levee projects are summarized in TABLE 5. Benefit-cost ratios for the 21 angler-use sites are shown in TABLE 6.

SECTION III - ALLOCATION AND APPORTIONMENT OF COST

6. RESERVOIRS

Cost allocations have been made on the basis of a 100-year economic life and on the basis of the separable costs-remaining benefits method. An analysis has been made for two different amortization periods, both 50 and 100 years as the periods of time selected for economic recovery of the project's net investment. Shown in TABLES 7 and 8 are the cost allocations for the reservoirs for 50- and 100-year amortization periods, respectively. The division of project costs between Federal and non-Federal interests was based on allocation of costs to the project purposes and presently applicable laws and regulations governing cost-sharing practices. In accordance with the general principles of the Flood Control Act of 1936, all costs allocated to flood control are considered to be Federal. Costs allocated to water supply have been assigned to non-Federal interests in accordance with the Water Supply Act of 1958, as amended. Costs allocated to water quality control are defined as Federal cost as provided under the Federal Water Pollution Control Act of 1961, since the benefits are widespread. Navigation and area reorientation costs also have been assigned to the Federal Government. Project costs allocated to recreation for the main stream and tributary stream reservoirs have been apportioned between Federal and non-Federal interests in accordance with the cost-sharing policy outlined in HR 9032, 88th Congress. Since headwater reservoirs are considered local improvements, sponsoring local organizations for the headwater reservoirs will assume the cost of lands, easements, and rights-of-way, including relocations and access roads, for all works of improvement for purposes other than public fish and wildlife and recreational development, plus 50 percent of the cost allocated to recreation. To avoid any duplication, the share of joint-use costs for land, easements, and rights-of-way, relocations and access roads distributed to recreation, have been deleted from the total cost allocated to recreation. In addition, non-Federal interests would be required to assume the entire cost of operation and maintenance, including major replacements. A summary of cost apportionment between Federal and non-Federal interests for the reservoirs is shown in TABLE 9. Costs apportioned to water supply have been divided into two phases: the cost for storage required to meet the immediate and future needs over the first 50 years; and the cost for storage converted to meet the long-term needs covering the last 50 years of the period of analysis. Division of the initial and future costs for water supply is shown in TABLE 10.

7. LOCAL PROTECTION

Of the total project first costs, non-Federal interests will furnish all lands, easements, and rights-of-way; bear all property damage costs; and pay for alterations and relocations of lands and utilities. The remainder of the first costs would be borne by the Federal Government. Non-Federal interests will bear all operation and maintenance expenses, including replacement of facilities, for the projects.

Apportionment of costs for local protection levees between Federal and non-Federal interests is shown in TABLE 11.

8. ANGLER-USE SITES

Total project first costs for these sites have been assumed to be a Federal responsibility. Operation and maintenance, including replacement of facilities, will be the responsibility of non-Federal interests. Apportionment of costs for angler-use sites is shown in TABLE 12.

TABLE 1
Total project costs - reservoirs

Main stream reservoirs

Reservoir	Total project cost
Pine Ford (2A)	$ 24,200,000
Irondale (9)	13,500,000
Meramec Park (17)	37,700,000
Union (29)	25,600,000
Total for main stream reservoirs	$101,000,000

Tributary reservoirs

West Fork Huzzah Creek (I-26)	$ 4,280,000
Spring Creek (I-28)	4,780,000
Bourbeuse River (I-38)	5,610,000
Total for tributary reservoirs	$ 14,670,000

Headwater reservoirs

Dry Creek (H-3)	$ 419,000
Brady Creek (H-5A)	362,000
Little Indian Creek (H-8)	1,020,000
Bates Creek (H-9)	566,000
Boone Creek (H-13A)	761,000
Big River (H-25)	571,000
Total for headwater reservoirs	$ 3,699,000
Total for all reservoirs	$119,369,000

TABLE 2
Total project costs - local protection projects

Levee area	Total project cost
No. 4, Starling Airport	$ 2,728,000
No. 8, West Watson Road	891,000
No. 9, Weiss Airport	1,650,000
No. 11, Valley Park	1,639,000
No. 12, Peerless Park	2,293,000

TABLE 3
Total project costs - angler-use sites

Controlling reservoir	Site designation	Name	Project first cost *
BIG RIVER SUB-BASIN			
Irondale (#9)	A	Highway 8	
	B	Terre Bleue Creek	
	C	Highway E	
	D	Washington Park	$ 117,000
Pine Ford (#2A)	E	Morse Mill	
	F	Island	
	G	Cedar Hill	
	H	Rockford Beach	
	I	Meramec River Confluence	134,000
MERAMEC RIVER SUB-BASIN			
I-28 (Below Maramec Spring)	M	1,000 Oaks	
	N	Idlewild	
	O	Highway 19	84,000
Meramec Park (#17)	P	Cove Church	
	Q	Little Meramec River	
	R	Robertsville	84,000
I-26	S	Huzzah	
	T	Highway 8	50,000
BOURBEUSE RIVER SUB-BASIN			
Union (#29)	W	Beuscher Creek	
	X	Highway 50	
	Y	Highway 66	
	Z	Meramec River Confluence	117,000

* All angler-use sites below a reservoir analyzed as a total combined system.

TABLE 4
Benefit-cost ratios - reservoirs

Reservoir	Benefits (1)	Average annual charges (2) 100-year	50-year	Benefit-cost ratio 100-year	50-year
Main stream reservoirs					
2A	$ 2,374,100	$1,200,800	$ 1,367,900	2.0	1.7
9	1,374,000	676,100	773,800	2.0	1.8
17	4,678,300	1,941,800	2,201,500	2.4	2.1
29	3,159,400	1,244,800	1,421,100	2.5	2.2
Tributary stream reservoirs					
I-26 (with I-14 out)	225,500	202,300	233,600	1.1	0.97
I-28 (with I-23 out)	463,200	259,800	293,300	1.8	1.6
I-38	590,200	343,800	383,400	1.7	1.5
Headwater reservoirs					
H-3	92,400	30,600	33,100	3.0	2.8
H-5A	55,400	26,400	28,800	2.1	1.9
H-8	171,500	55,700	62,000	3.1	2.8
H-9	55,000	30,400	34,100	1.8	1.6
H-13A	150,900	45,400	50,000	3.3	3.0
H-25	32,900	30,500	33,400	1.1	0.99

(1) Total net benefits.
(2) Based on economic costs and amortization periods of 50 and 100 years.

TABLE 5
Benefit-cost ratios - local protection projects

Levee area	Benefits	Average annual charges (1) 100-year	50-year	Benefit-cost ratio 100-year	50-year
#4 Starling Airport	136,100	108,100	127,700	1.3	1.1
#8 West Watson Road	350,200	35,000	41,400	10.0	8.5
#9 Weiss Airport	384,100	69,700	81,600	5.5	4.7
#11 Valley Park	70,100	65,900	77,800	1.1	0.9
#12 Peerless Park	627,300	104,500	121,000	6.0	5.2

(1) Based on economic costs and amortization periods of 50 and 100 years.

TABLE 6

Benefit-cost ratios - angler-use sites

Controlling reservoir	Site designation	Benefits	Average annual charges 100-year	Average annual charges 50-year	Benefit-cost ratio 100-year	Benefit-cost ratio 50 year
BIG RIVER SUB-BASIN						
#9 Irondale	A B C D	$ 36,400	$ 20,000	$ 20,800	1.82	1.75
#2A Pine Ford	E F G H I	47,500	23,700	24,700	2.00	1.92
MERAMEC RIVER SUB-BASIN						
I-28 (below Maramec Spring)	M N O	22,500	11,300	11,900	1.99	1.89
#17 Meramec Park	P Q R	54,000	15,700	16,300	3.44	3.31
I-26	S T	16,200	6,900	7,200	2.35	2.25
BOURBEUSE RIVER SUB-BASIN						
#29 Union	W X Y Z	37,200	20,200	21,000	1.84	1.77

TABLE 7
Allocation of costs - reservoirs (50-year amortization period)

Reservoirs	Flood control	Water quality	Water supply	Total recreation	Area reorientation	Navigation	Total
MAIN STREAM RESERVOIRS							
#2A Pine Ford							
First cost	$ 9,204,000	$1,203,000	$ 295,000	$ 7,892,000	$5,500,000	$106,000	$24,200,000
Operation & maintenance	44,300	19,000	4,200	204,300	12,900	300	285,000
#9 Irondale							
First cost	663,000	4,013,000	468,000	5,024,000	3,180,000	152,000	13,500,000
Operation & maintenance	30,300	30,000	3,500	111,700	16,700	800	193,000
#17 Meramec Park							
First cost	10,119,000	4,691,000	1,203,000	13,906,000	7,343,000	438,000	37,700,000
Operation & maintenance	50,000	51,600	1,500	351,900	-	-	455,000
#29 Union							
First cost	5,890,000	2,903,000	5,275,000	7,442,000	3,775,000	315,000	25,600,000
Operation & maintenance	38,400	4,300	54,300	166,500	400	100	264,000
TRIBUTARY STREAM RESERVOIRS							
I-26 West Fork Huzzah Creek							
First cost	946,000	-	164,000	1,291,000	1,879,000	-	4,280,000
Operation & maintenance	13,900	-	1,000	33,900	9,200	-	58,000
I-28 Spring Creek							
First cost	853,000	1,376,000	159,000	1,342,000	1,050,000	-	4,780,000
Operation & maintenance	17,800	21,400	800	45,400	5,600	-	91,000
I-38 Bourbeuse River							
First cost	945,000	1,582,000	205,000	1,377,000	1,501,000	-	5,610,000
Operation & maintenance	34,300	32,000	2,700	68,400	10,600	-	148,000
HEADWATER RESERVOIRS							
H-3 Dry Creek							
First cost	178,000	-	-	136,000	105,000	-	419,000
Operation & maintenance	3,200	-	-	8,300	3,000	-	14,500
H-5A Brady Creek							
First cost	154,000	-	-	123,000	85,000	-	362,000
Operation & maintenance	6,400	-	-	7,100	-	-	13,500
H-8 Little Indian Creek							
First cost	296,000	-	-	317,000	407,000	-	1,020,000
Operation & maintenance	2,700	-	-	12,600	2,600	-	17,900
H-9 Bates Creek							
First cost	250,000	-	-	175,000	141,000	-	566,000
Operation & maintenance	2,100	-	-	6,000	1,900	-	10,000
H-13A Boone Creek							
First cost	355,000	-	-	172,000	234,000	-	761,000
Operation & maintenance	2,900	-	-	10,300	3,100	-	16,300
H-25 Big River							
First cost	Separable cost for flood control greater than accruable benefit.						571,000
Operation & maintenance	Without flood control benefits, reservoir is not economically justified.						9,600

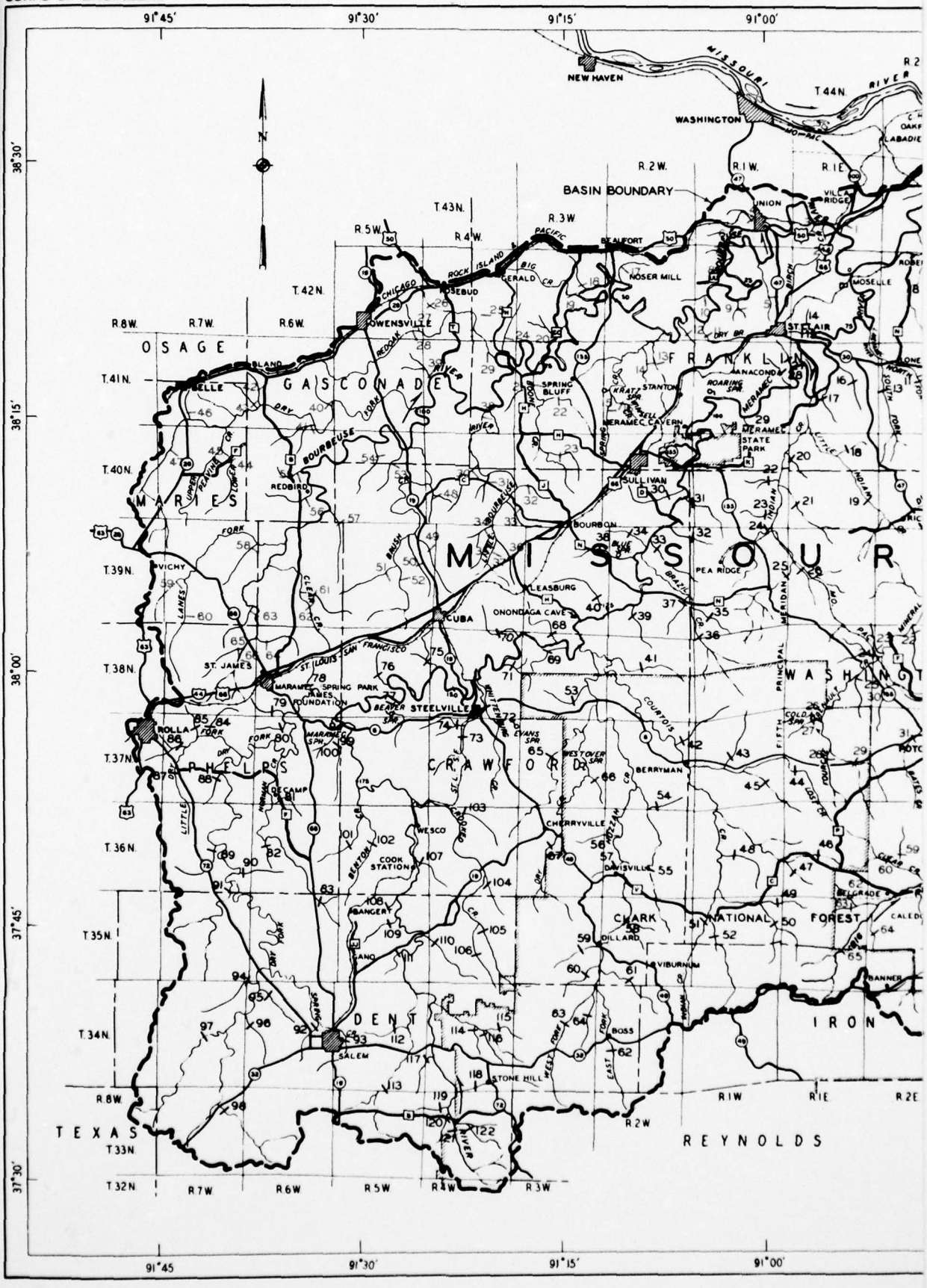
TABLE 8
Allocation of costs - reservoirs (100-year amortization period)

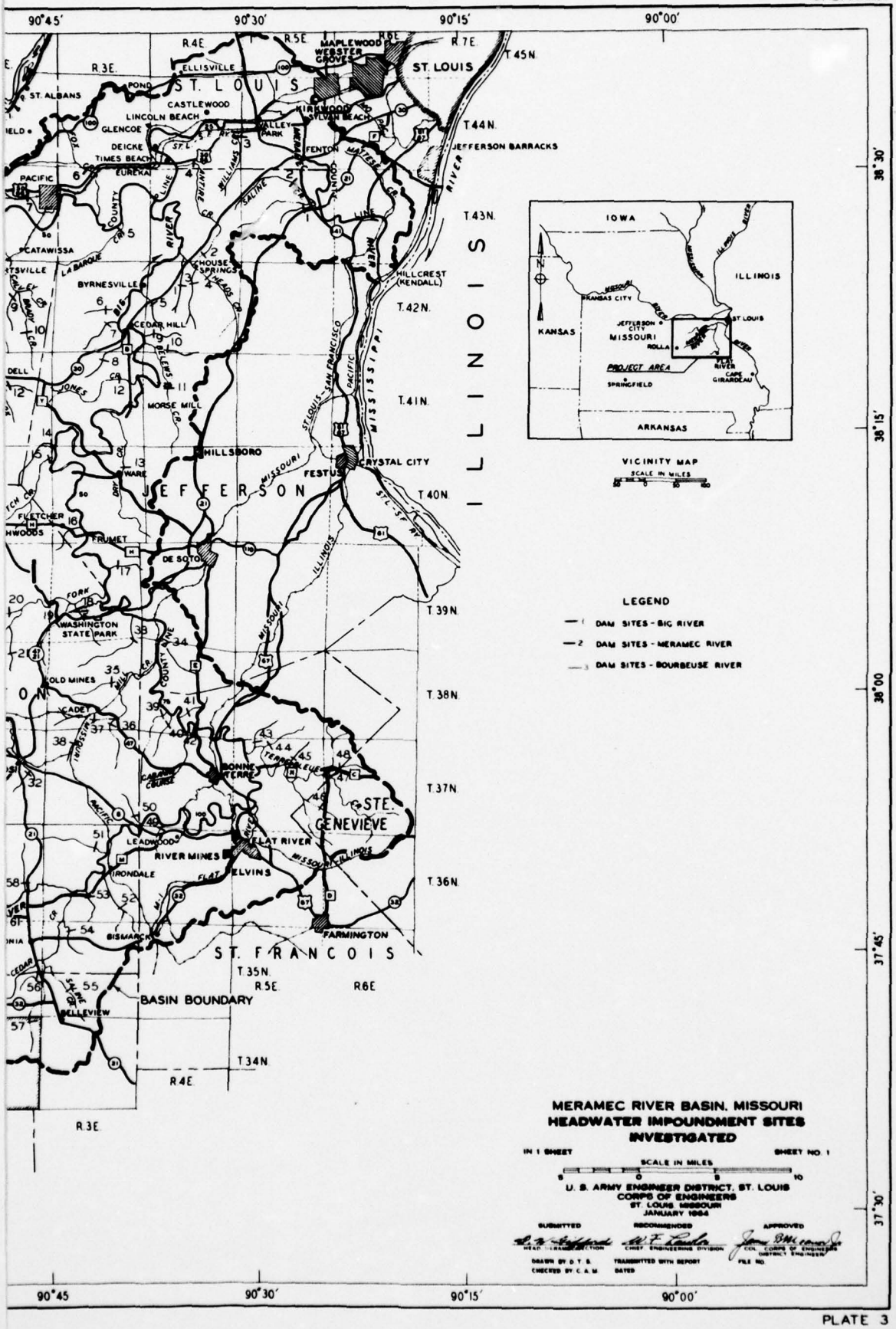
Reservoir	Flood control	Water quality	Water supply	Total recreation	Area reorientation	Navigation	Total
MAIN STREAM RESERVOIRS							
#2A Pine Ford							
First cost	$ 9,816,000	$1,257,000	$ 308,000	$ 7,037,000	$5,673,000	$109,000	$24,200,000
Operation & maintenance	45,700	19,100	4,300	202,400	13,300	200	285,000
#9 Irondale							
First cost	724,000	3,770,000	522,000	4,738,000	3,575,000	171,000	13,500,000
Operation & maintenance	30,700	28,700	3,700	110,300	18,700	900	193,000
#17 Meramec Park							
First cost	10,631,000	4,874,000	1,246,000	12,933,000	7,565,000	451,000	37,700,000
Operation & maintenance	50,000	51,600	1,500	351,900	-	-	455,000
#29 Union							
First cost	6,155,000	2,975,000	5,445,000	6,834,000	3,868,000	323,000	25,600,000
Operation & maintenance	38,400	4,300	54,400	166,500	400	-	264,000
TRIBUTARY STREAM RESERVOIRS							
I-26 West Fork Huzzah Creek							
First cost	991,000	-	172,000	1,178,000	1,939,000	-	4,280,000
Operation & maintenance	14,100	-	1,000	33,200	9,700	-	58,000
I-28 Spring Creek							
First cost	908,000	1,321,000	169,000	1,284,000	1,098,000	-	4,780,000
Operation & maintenance	18,000	21,100	900	45,100	5,900	-	91,000
I-38 Bourbeuse River							
First cost	1,006,000	1,618,000	211,000	1,253,000	1,522,000	-	5,610,000
Operation & maintenance	34,700	32,300	2,700	67,500	10,800	-	148,000
HEADWATER RESERVOIRS							
H-3 Dry Creek							
First cost	173,000	-	-	136,000	110,000	-	419,000
Operation & maintenance	3,100	-	-	8,300	3,100	-	14,500
H-5A Brady Creek							
First cost	148,000	-	-	129,000	85,000	-	362,000
Operation & maintenance	6,400	-	-	7,100	-	-	13,500
H-8 Little Indian Creek							
First cost	309,000	-	-	313,000	398,000	-	1,020,000
Operation & maintenance	2,700	-	-	12,600	2,600	-	17,900
H-9 Bates Creek							
First cost	263,000	-	-	161,000	142,000	-	566,000
Operation & maintenance	2,300	-	-	5,900	1,800	-	10,000
H-13A Boone Creek							
First cost	366,000	-	-	164,000	231,000	-	761,000
Operation & maintenance	2,900	-	-	10,300	3,100	-	16,300
H-25 Big River							
First cost	54,000	-	-	270,000	247,000	-	571,000
Operation & maintenance	1,200	-	-	6,500	1,900	-	9,600

TABLE 9
Cost apportionment summary - reservoirs

Reservoir	Federal		Non-Federal		Total	
	50-year	100-year	50-year	100-year	50-year	100-year
MAIN STREAM RESERVOIRS						
#2A Pine Ford						
First cost	$ 22,947,000	$ 23,789,000	$ 1,253,000	$ 411,000	$ 24,200,000	$ 24,200,000
Operation & maintenance	280,800	280,700	4,200	4,300	285,000	285,000
#9 Irondale						
First cost	12,899,000	12,978,000	601,000	522,000	13,500,000	13,500,000
Operation & maintenance	189,500	189,300	3,500	3,700	193,000	193,000
#17 Meramec Park						
First cost	36,467,000	36,454,000	1,233,000	1,246,000	37,700,000	37,700,000
Operation & maintenance	453,500	453,500	1,500	1,500	455,000	455,000
#29 Union						
First cost	20,313,000	20,155,000	5,287,000	5,445,000	25,600,000	25,600,000
Operation & maintenance	209,700	209,600	54,300	54,400	264,000	264,000
TRIBUTARY STREAM RESERVOIRS						
I-26 West Fork Huzzah Creek						
First cost	4,116,000	4,108,000	164,000	172,000	4,280,000	4,280,000
Operation & maintenance	57,000	57,000	1,000	1,000	58,000	58,000
I-28 Spring Creek						
First cost	4,621,000	4,611,000	159,000	169,000	4,780,000	4,780,000
Operation & maintenance	90,200	90,100	800	900	91,000	91,000
I-38 Bourbeuse River						
First cost	5,405,000	5,399,000	205,000	211,000	5,610,000	5,610,000
Operation & maintenance	145,300	145,300	2,700	2,700	148,000	148,000
HEADWATER RESERVOIRS						
H-3 Dry Creek						
First cost	251,000	251,000	168,000	168,000	419,000	419,000
Operation & maintenance	-	-	14,500	14,500	14,500	14,500
H-5A Brady Creek						
First cost	216,000	213,000	146,000	149,000	362,000	362,000
Operation & maintenance	-	-	13,500	13,500	13,500	13,500
H-8 Little Indian Creek						
First cost	628,000	628,000	392,000	392,000	1,020,000	1,020,000
Operation & maintenance	-	-	17,900	17,900	17,900	17,900
H-9 Bates Creek						
First cost	380,000	386,000	186,000	180,000	566,000	566,000
Operation & maintenance	-	-	10,000	10,000	10,000	10,000
H-13A Boone Creek						
First cost	476,000	478,000	285,000	283,000	761,000	761,000
Operation & maintenance	-	-	16,300	16,300	16,300	16,300
H-25 Big River						
First cost	-	321,000	-	250,000	571,000	571,000
Operation & maintenance	-	-	-	9,600	-	9,600

CORPS OF ENGINEERS





MERAMEC RIVER BASIN, MISSOURI
HEADWATER IMPOUNDMENT SITES
INVESTIGATED

IN 1 SHEET — SHEET NO. 1

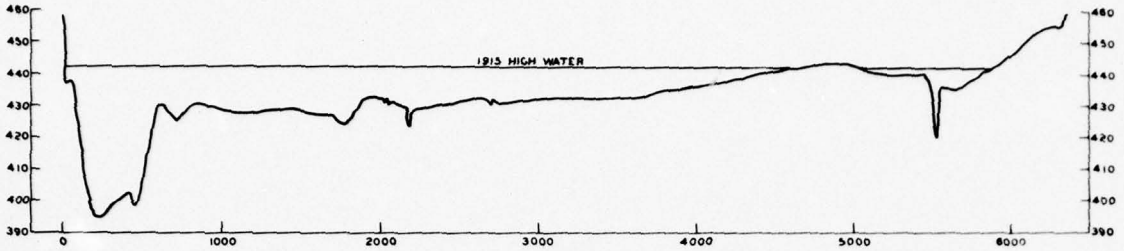
SCALE IN MILES

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS MISSOURI
JANUARY 1964

SUBMITTED — RECOMMENDED — APPROVED

DRAWN BY D. T. S.
CHECKED BY C. A. M.
TRANSMITTED WITH REPORT DATED
FILE NO.

PLATE 3



MILE 30.7
NEAR TIMES BEACH

VALLEY CROSS SECTIONS
LOOKING DOWNSTREAM
HORIZONTAL SCALE IN FEET
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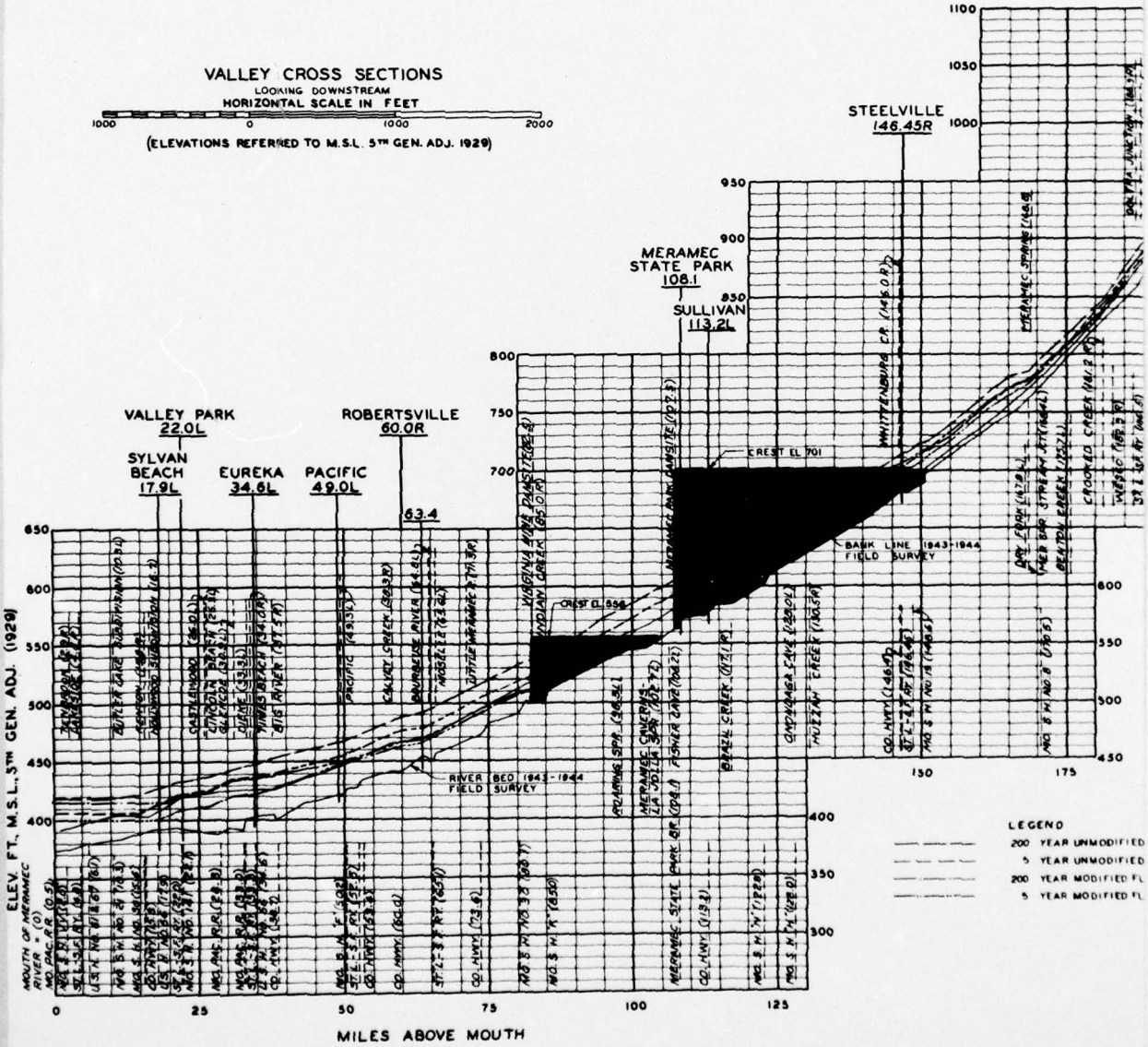
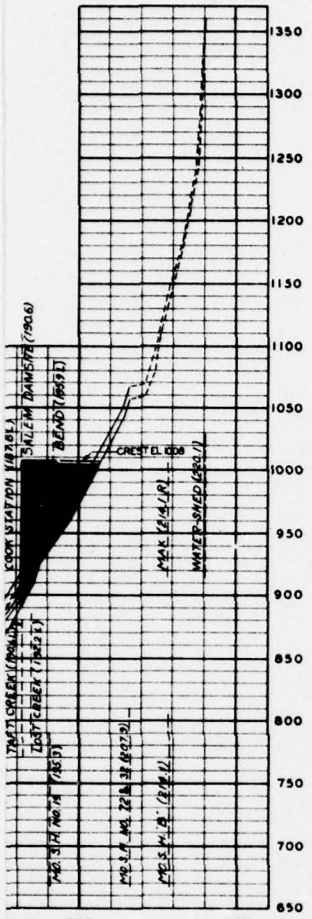
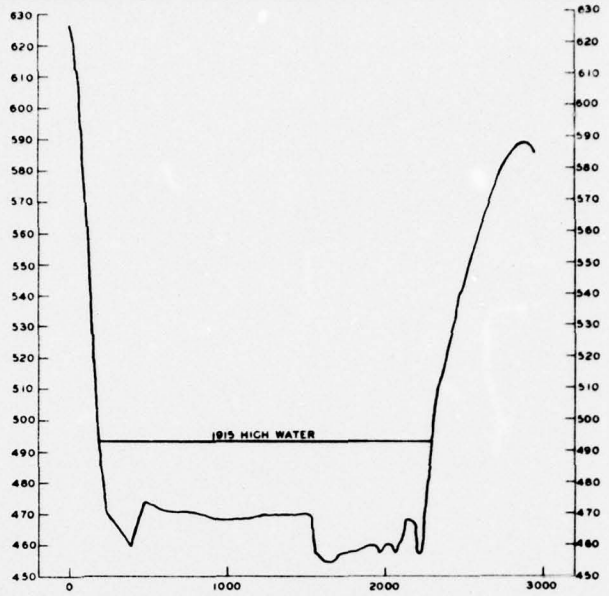
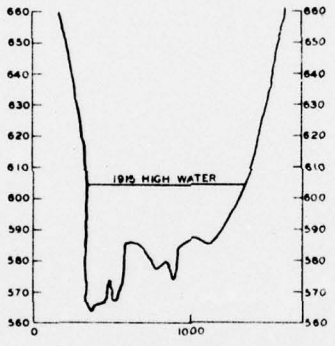
(ELEVATIONS REFERRED TO M.S.L. 5TH GEN. ADJ. 1929)



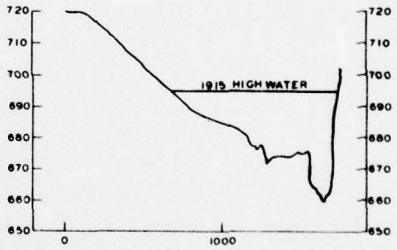




MILE 63.4
NEAR MOUTH OF BOURBEUSE



MILE 107.55
MERAMEC STATE PARK



MILE 142.2
NEAR BIRDS NEST

MILE 207.0
NEAR INDIAN TRAIL STATE PARK

NOTES

Data relating to the location of towns, Federal, state and county highway bridges, springs, caves and tributaries were secured from U.S. Geological Survey maps, county highway maps prepared by the Missouri State Highway Department and from the records of a field survey extending from the mouth to mile 22.3 completed by the U.S. Engineer Department in 1935. Gage locations were obtained from the records of the Missouri Geological Survey and Water Resources and the U.S. Weather Bureau.

Bank and river bed profiles from the mouth to mile 192.8 are based on field survey data collected by the U.S. Engineer Department and from mile 192.8 to mile 208.2 on field data secured by U.S. Department of Agriculture survey parties. The portions of the profiles between mile 208.2 and the source of the stream, indicated by dashed lines, represent information secured from maps but not checked by field surveys.

FLOW
FLOW
OW
OW

The designations R and L applied to locations refer to right or left bank looking downstream.

The abbreviation Mo. S.H. indicates ownership of bridge by Missouri State Highway Department.

Stream gage locations are written horizontally above the profile.

MERAMEC RIVER BASIN, MISSOURI
MERAMEC RIVER
PROFILE

IN 1 SHEET
SHEET NO. 1
SCALE AS SHOWN

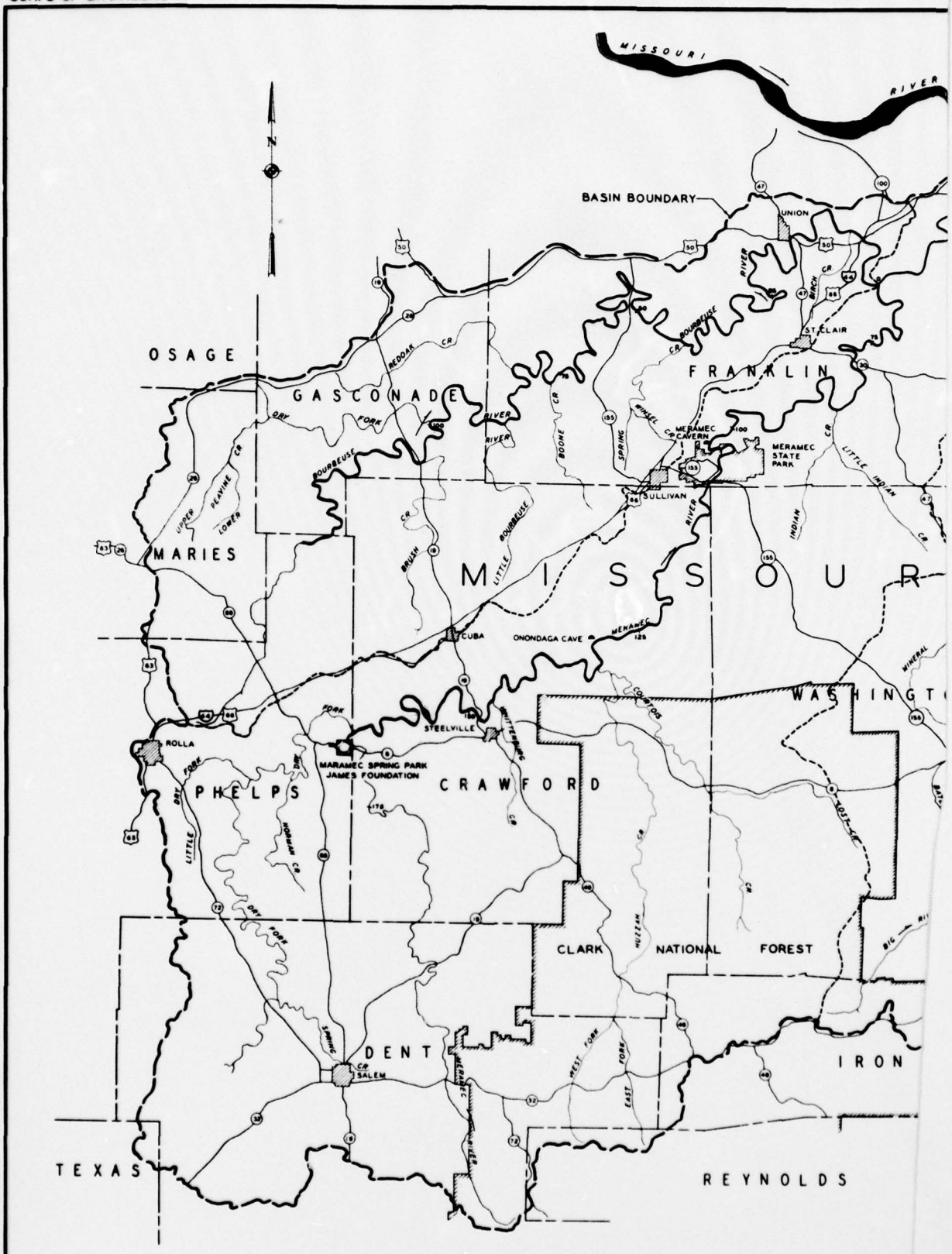
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
JANUARY 1964

SUBMITTED — HEAD, MERAMEC SECTION
RECOMMENDED — CHIEF, ENGINEERING DIVISION
APPROVED — COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

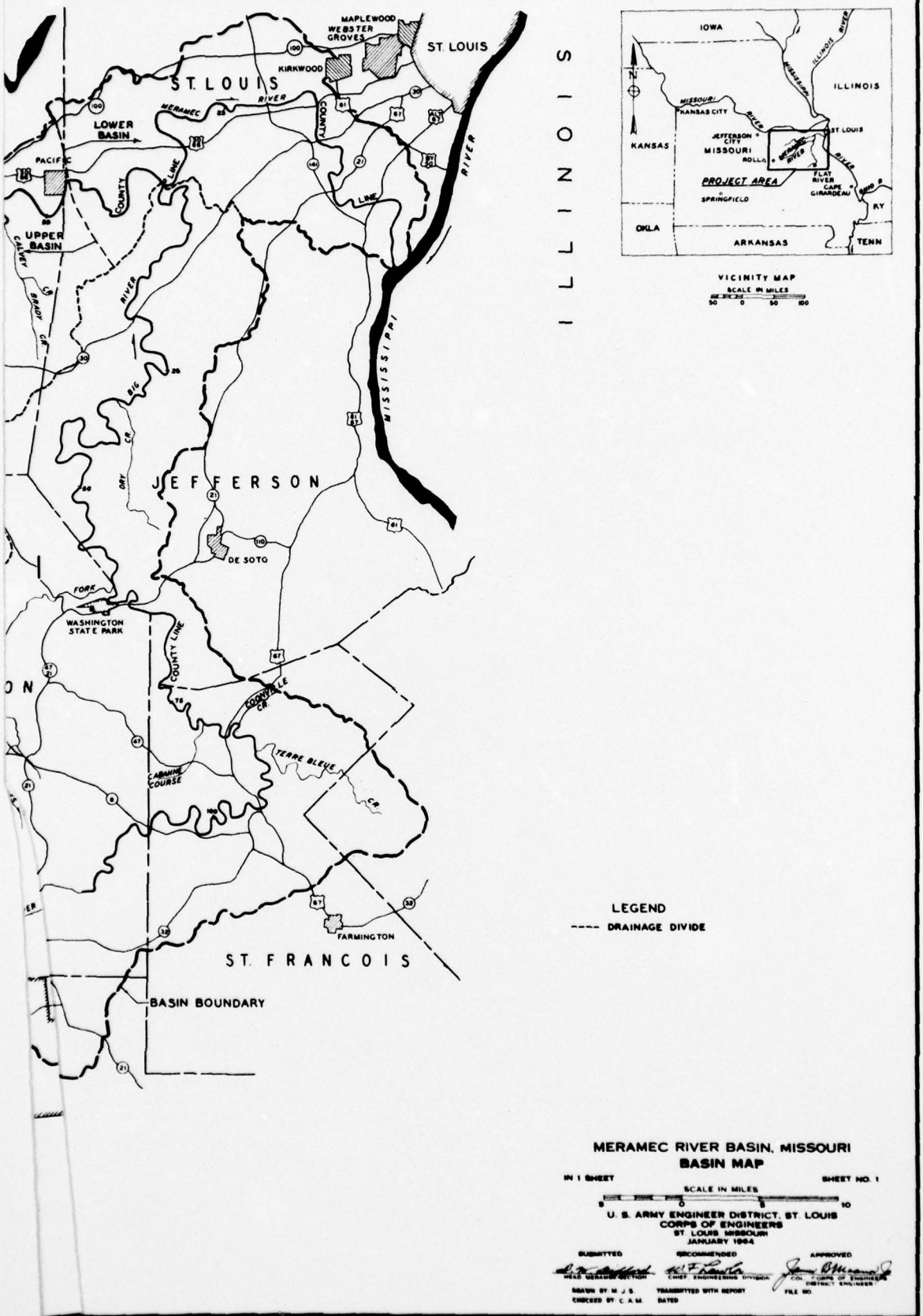
DRAWN BY J. S.
CHECKED BY C.A.M.
TRANSMITTED WITH REPORT DATED
FILE NO.

PLATE 4

CORPS OF ENGINEERS



U. S. ARMY



MERAMEC RIVER BASIN, MISSOURI
BASIN MAP

IN 1 SHEET SHEET NO. 1

SCALE IN MILES

5 0 5 10

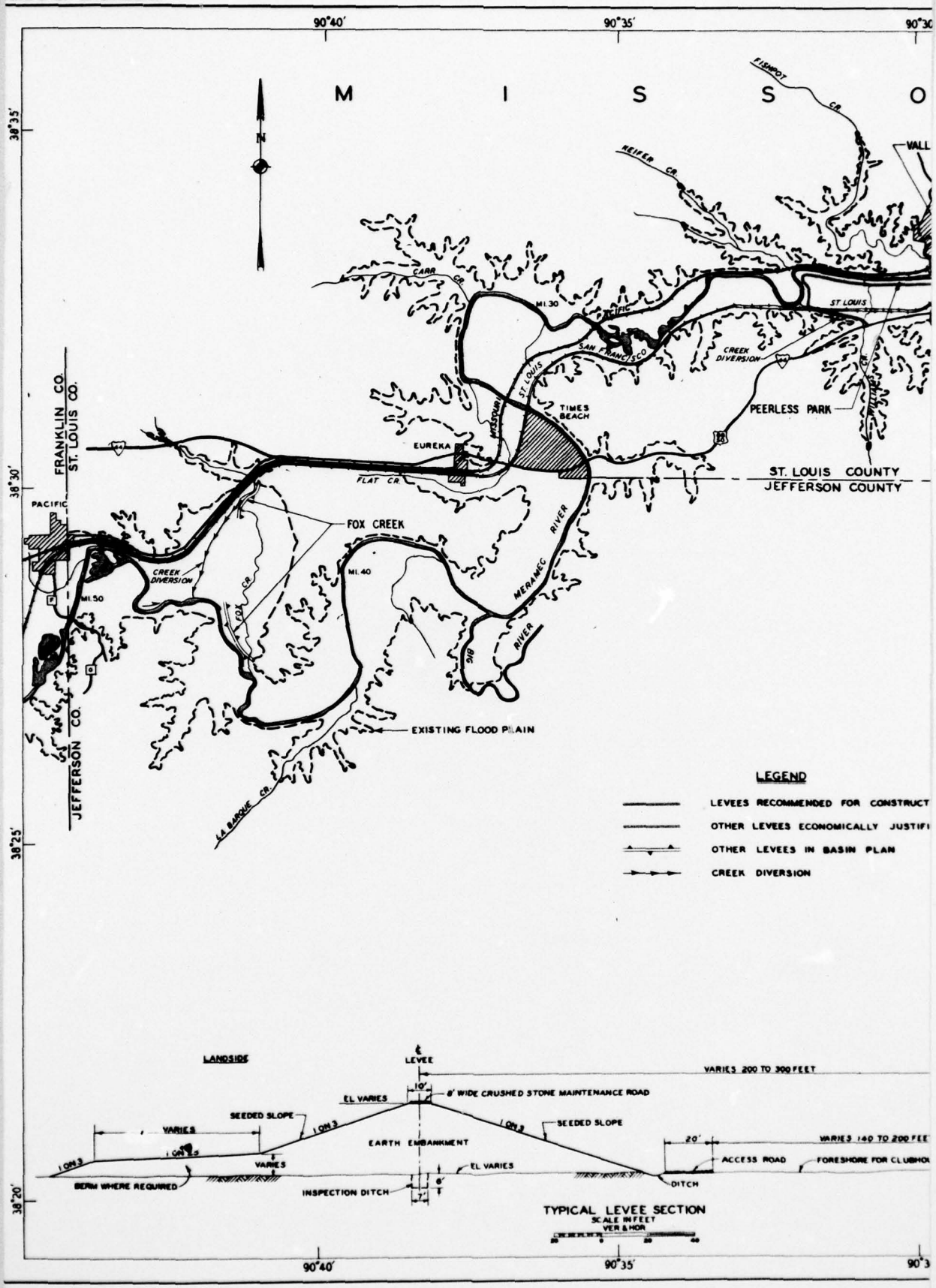
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
JANUARY 1964

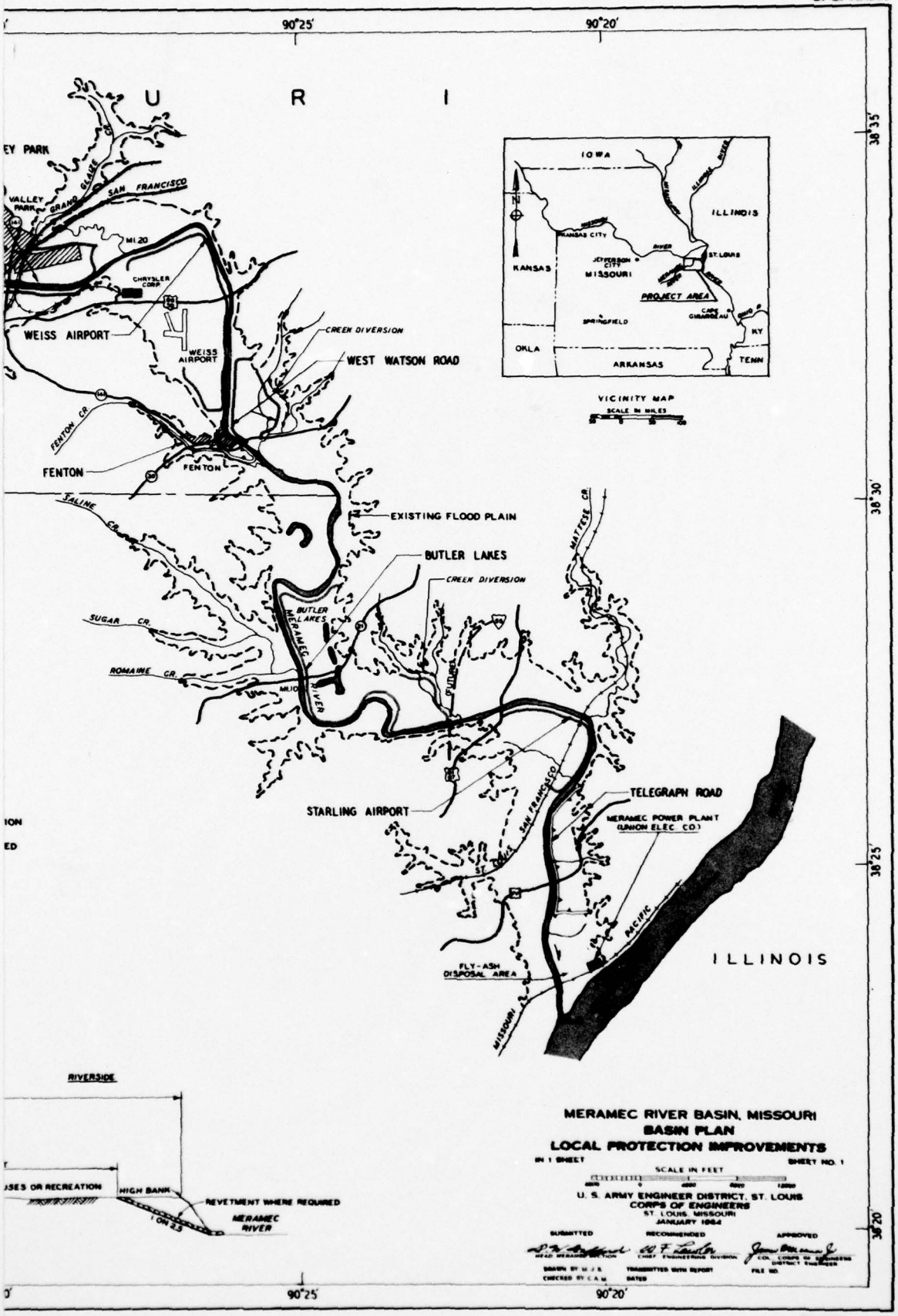
SUBMITTED RECOMMENDED APPROVED

HEAD, ENGINEERING DIVISION CHIEF, ENGINEERING DIVISION COL., CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY M. J. S. TRANSMITTED WITH REPORT FILE NO.
CHECKED BY C. A. M. DATED

PLATE 1


90°40'
90°35'
90°30'
38°35'
38°30'
38°25'
38°20'
M I S S O
N
FISHPOT CR.
KEIFER CR.
VALL
CARR CR.
MI. 30
PACIFIC
ST. LOUIS
SAN FRANCISCO
CREEK DIVERSION
ST. LOUIS
MISSOURI
TIMES BEACH
PEERLESS PARK
EUREKA
FLAT CR.
FRANKLIN CO.
ST. LOUIS CO.
ST. LOUIS COUNTY
JEFFERSON COUNTY
PACIFIC
FOX CREEK
CREEK DIVERSION
MI. 50
MI. 40
FOX CR.
MERAMEC RIVER
DRY RIVER
JEFFERSON CO.
EXISTING FLOOD PLAIN
LA BARQUE CR.
LEGEND
LEVEES RECOMMENDED FOR CONSTRUCT
OTHER LEVEES ECONOMICALLY JUSTIFI
OTHER LEVEES IN BASIN PLAN
CREEK DIVERSION
LANDSIDE
℄ LEVEE
VARIES 200 TO 300 FEET
EL VARIES
10'
8' WIDE CRUSHED STONE MAINTENANCE ROAD
SEEDED SLOPE
1 ON 3
VARIES
1 ON 3
EARTH EMBANKMENT
1 ON 3
SEEDED SLOPE
20'
VARIES 140 TO 200 FEE
ACCESS ROAD
FORESHORE FOR CLUBHO
VARIES
EL VARIES
BERM WHERE REQUIRED
INSPECTION DITCH
6'
7'
DITCH
TYPICAL LEVEE SECTION
SCALE IN FEET
VER & HOR
0
20
40



MERAMEC RIVER BASIN, MISSOURI
BASIN PLAN
LOCAL PROTECTION IMPROVEMENTS

IN 1 SHEET — SHEET NO. 1

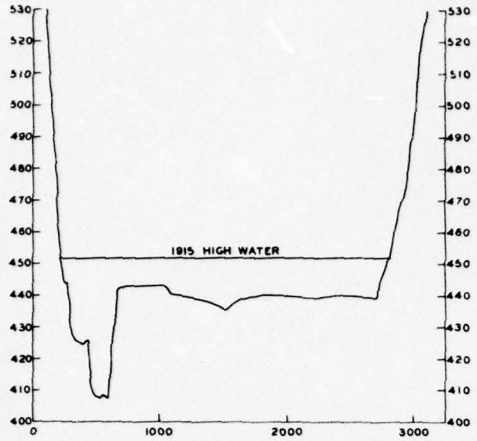
SCALE IN FEET

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
JANUARY 1964

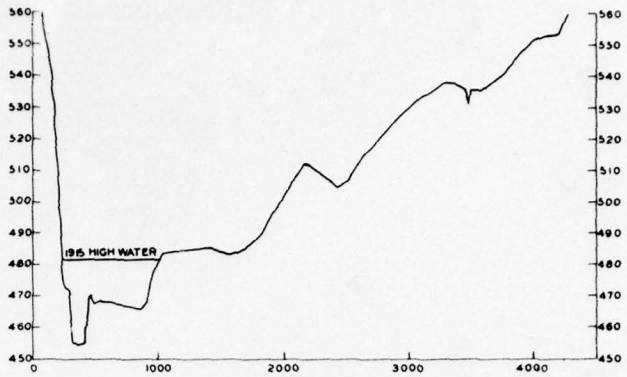
SUBMITTED — RECOMMENDED — APPROVED

DRAWN BY M. J. S. — TRANSMITTED WITH REPORT — FILE NO.
CHECKED BY C. A. M. — DATED

PLATE 8



MILE 0.5



MILE 22.6

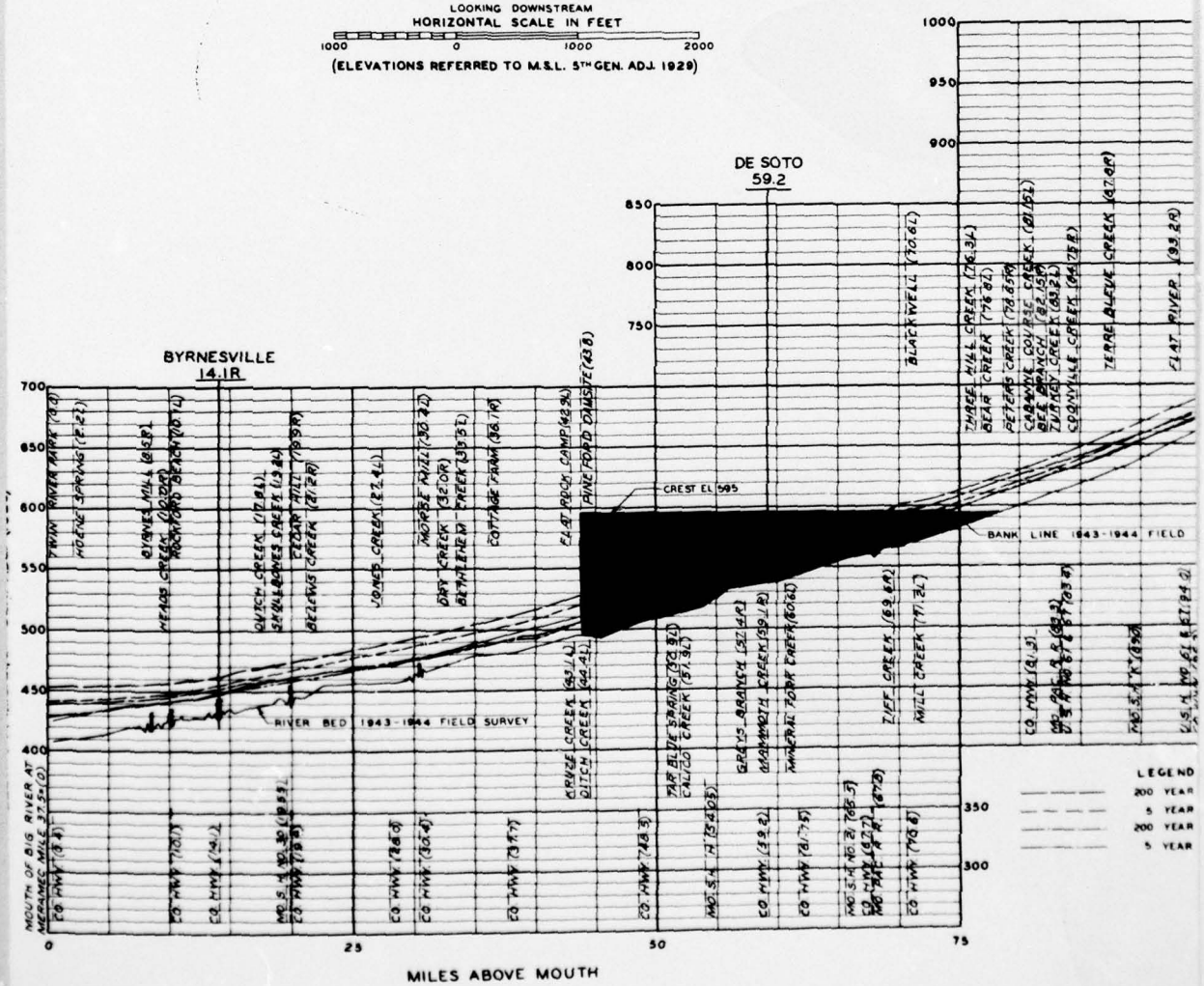
VALLEY CROSS SECTIONS

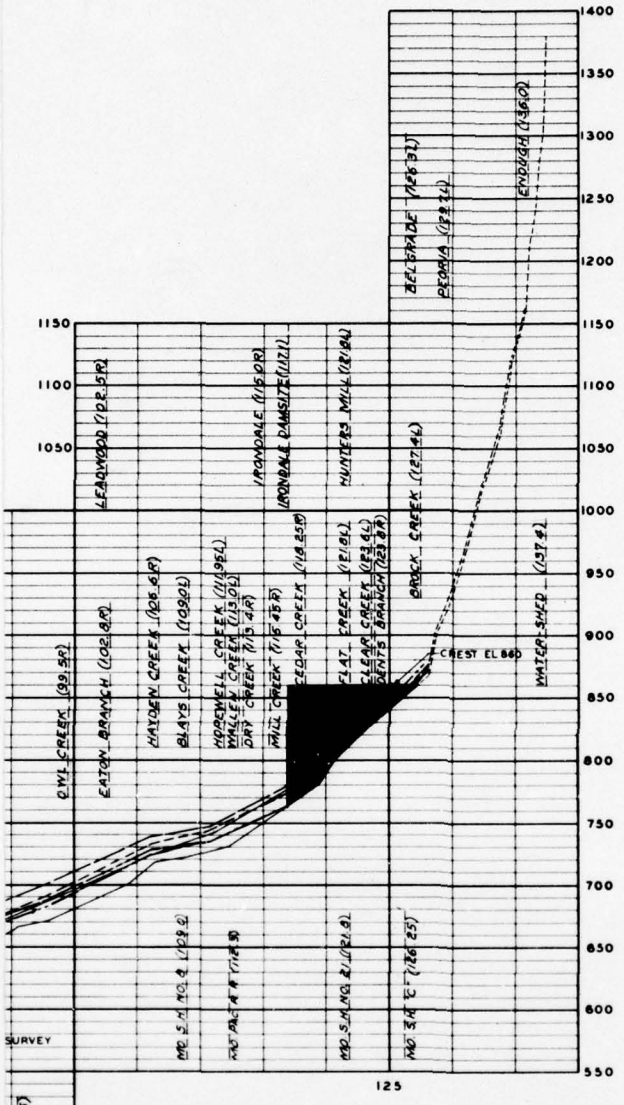
LOOKING DOWNSTREAM

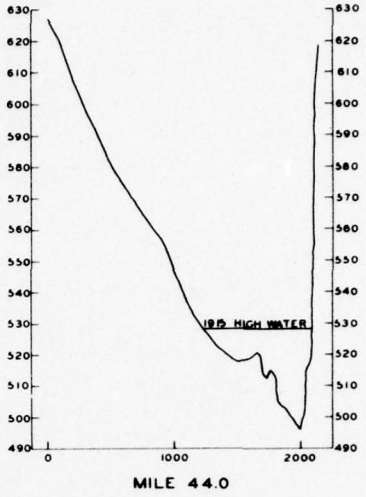
HORIZONTAL SCALE IN FEET

1000 0 1000 2000

(ELEVATIONS REFERRED TO M.S.L. 5TH GEN. ADJ. 1929)







NOTES

Data relating to the location of towns, Federal, state and county highway bridges springs and tributaries were secured from U.S Geological Survey maps and from county highway maps prepared by the Missouri State Highway Department. Gage locations were obtained from the records of the Missouri Geological Survey and Water Resources, and the U.S. Weather Bureau.

Bank and river bed profiles from the mouth to mile 117.4 are based on field data secured by survey parties under the direction of this office. The portions of the profiles between mile 117.4 and the source of the stream, indicated by dashed lines, represent information secured from maps but not checked by field surveys.

The designations R and L applied to locations refer to right or left bank looking downstream.

The abbreviation Mo. S.H. indicates ownership of bridge by the Missouri State Highway Department.

Stream gage locations are written horizontally above the profile.

MERAMEC RIVER BASIN, MISSOURI

BIG RIVER

PROFILE

IN 1 SHEET SHEET NO. 1

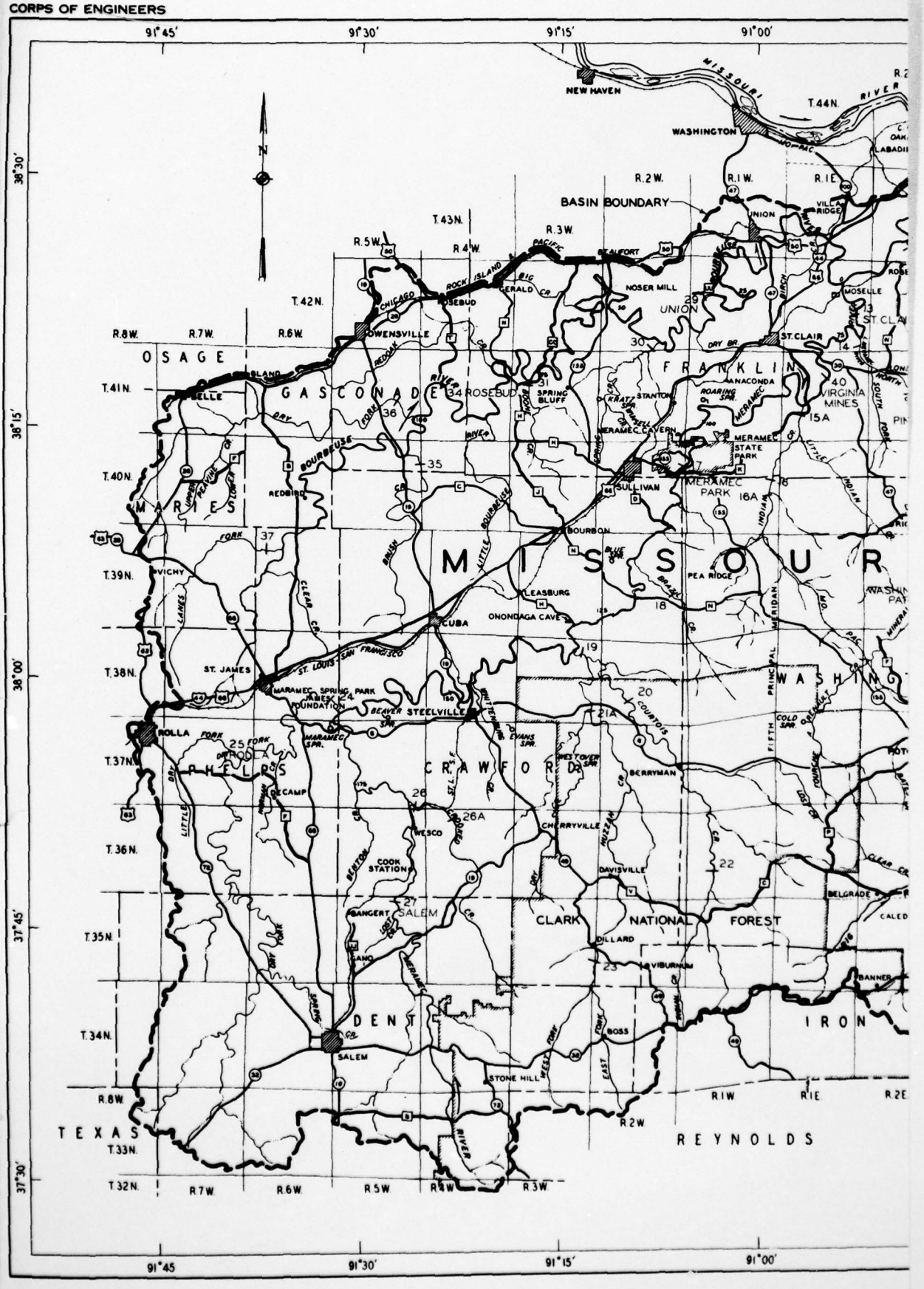
SCALE AS SHOWN

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
JANUARY 1964

SUBMITTED RECOMMENDED APPROVED

DRAWN BY J. S. TRANSMITTED WITH REPORT
CHECKED BY C. A. M. DATED FILE NO.

CORPS OF ENGINEERS



AD-A036 824 ARMY ENGINEER DISTRICT ST LOUIS MO F/G 8/6
MERAMEC RIVER, MISSOURI COMPREHENSIVE BASIN STUDY. VOLUME I. MA--ETC(U)
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4 OF 4
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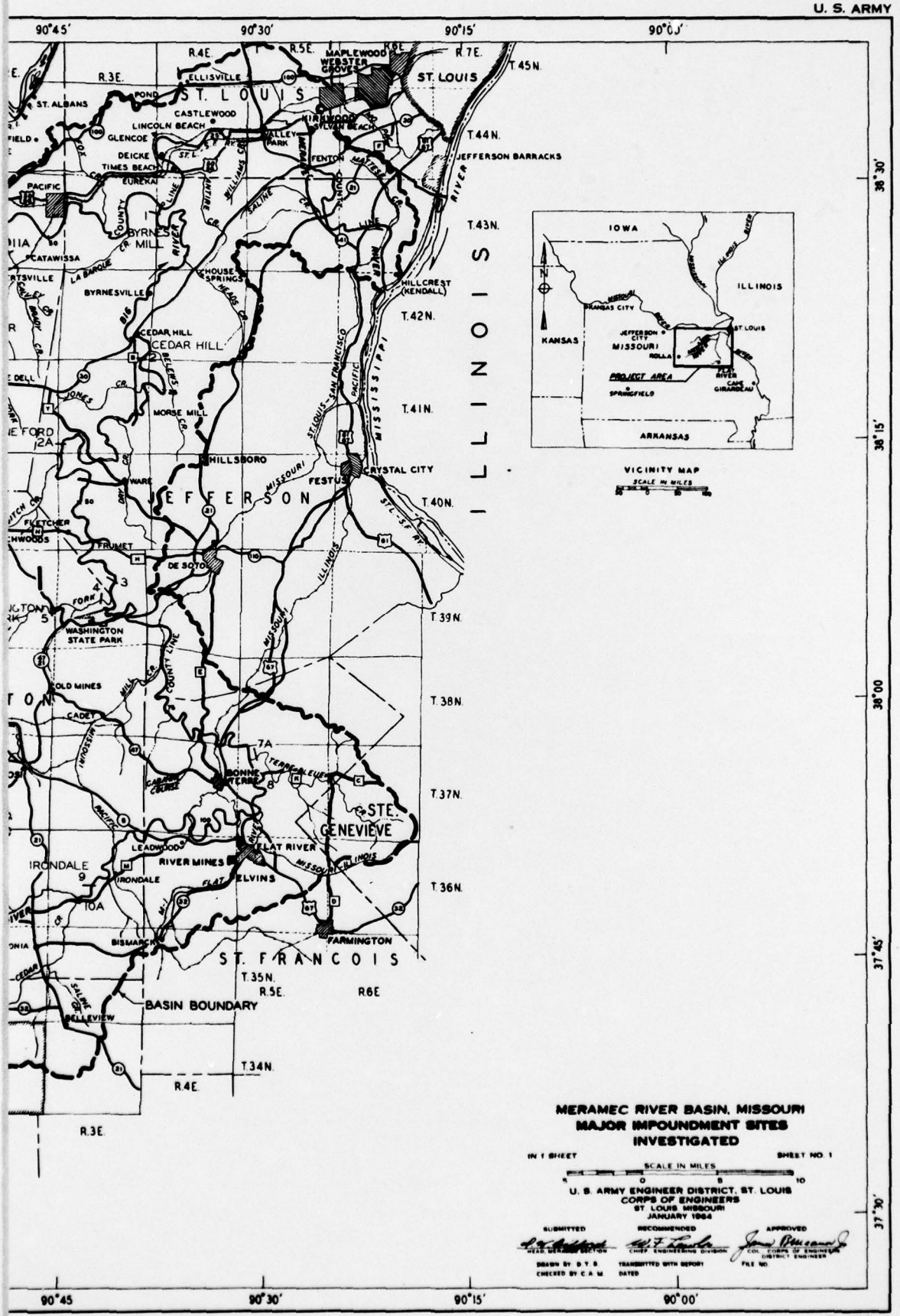
U. S. ARMY



MERAMEC RIVER BASIN, MISSOURI
MAJOR IMPOUNDMENT SITES INVESTIGATED

IN 1 SHEET — SHEET NO. 1

SCALE IN MILES 0 5 10

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
JANUARY 1964

SUBMITTED — RECOMMENDED — APPROVED

DRAWN BY D. T. S.
CHECKED BY C. A. M.
TRANSMITTED WITH REPORT DATED
FILE NO.

PLATE 2

TABLE 10
Costs - water supply
(Costs in thousands of dollars)

Reservoir	1st 50 years Initial cost	1st 50 years Percent of project cost	2nd 50 years Additional cost	2nd 50 years Percent of project cost	Total cost	Percent of project cost
MAIN STREAM RESERVOIRS						
#2A Pine Ford						
First cost	$ -	-	$ 308.0	1.27	$ 308.0	1.27
*Operation and maintenance	-	-	4.3	1.51	4.3	1.51
#9 Irondale						
First cost	-	-	522.0	3.87	522.0	3.87
*Operation and maintenance	-	-	3.7	1.92	3.7	1.92
#17 Meramec Park						
First cost	-	-	1,246.0	3.31	1,246.0	3.31
*Operation and maintenance	-	-	1.5	0.33	1.5	0.33
#29 Union						
First cost	2,483.0	9.70	2,962.0	11.57	5,445.0	21.27
*Operation and maintenance	24.8	9.40	29.6	11.21	54.4	20.61
TRIBUTARY RESERVOIRS						
I-26 West Fork Huzzah Creek						
First cost	-	-	172.0	4.02	172.0	4.02
*Operation and maintenance	-	-	1.0	1.72	1.0	1.72
I-28 Spring Creek						
First cost	-	-	169.0	3.54	169.0	3.54
*Operation and maintenance	-	-	0.9	0.99	0.9	0.99
I-38 Bourbeuse River						
First cost	-	-	211.0	3.76	211.0	3.76
*Operation and maintenance	-	-	2.7	1.82	2.7	1.82
Total main stream and tributary stream reservoirs						
First cost	$2,483.0		$5,590.0		$8,073.0	
*Operation and maintenance	24.8		43.7		68.5	

*Include replacement costs.

NOTE: Percentages are of total project cost.

TABLE 11
Apportionment of costs - local protection projects

Levee area	Project first costs			Annual operation and maintenance costs -
	Federal	Non-Federal	Total	Non-Federal
Starling Airport (No. 4)	$ 2,350,000	$ 378,000	$ 2,728,000	$ 20,000
West Watson Road (No. 8)	698,000	193,000	891,000	6,000
Weiss Airport (No. 9)	1,430,000	220,000	1,650,000	16,000
Valley Park (No. 11)	1,350,000	289,000	1,639,000	11,000
Peerless Park (No. 12)	1,910,000	383,000	2,293,000	30,000
Total costs	$ 7,738,000	$ 1,463,000	$ 9,201,000	$ 83,000

TABLE 12
Apportionment of costs - angler-use sites

Controlling reservoir	Site designation	Name	Project first costs Federal responsibility	Total operation and maintenance costs non-Federal responsibility
BIG RIVER SUB-BASIN				
Irondale (9)	A	Highway 8		
	B	Terre Bleue Creek		
	C	Highway E		
	D	Washington Park	$117,000	$16,300
Pine Ford (2A)	E	Morse Mill		
	F	Island		
	G	Cedar Hill		
	H	Rockford Beach		
	I	Meramec River confluence	134,000	19,500
MERAMEC RIVER SUB-BASIN				
I-28 (below Maramec Spring)	M	1,000 Oaks		
	N	Idlewild		
	O	Highway 19	84,000	8,600
Meramec Park (17)	P	Cove Church		
	Q	Little Meramec River		
	R	Robertsville	84,000	13,000
I-26	S	Huzzah		
	T	Highway 8	50,000	5,300
BOURBEUSE RIVER SUB-BASIN				
Union (29)	W	Beuscher Creek		
	X	Highway 50		
	Y	Highway 66		
	Z	Meramec River confluence	117,000	16,500
Total costs			$586,000	$79,200